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Main Criteria and Tools for Managers

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Preface

A typical character of some European countries, usually those referred to as "*Old Europe*", is the high percentage of small mid enterprises (SME) in their industrial systems. If one takes account that SMEs are supplying labor to about 90 million citizens, this justifies that about 20.7 million SMEs are the backbone of the European Union (EU) economy. During the period 2002–2008, indeed, SMEs exceeded large-scale enterprises in the creation of new jobs: the number of jobs increased in SMEs at a rate of 1.9% per year, whilst in large enterprises only at 0.8%. Internationally active SMEs yield better results: 25% of EU SME business has been exported in the last three years, with an employment growth of 7%.[1] There is also a strong relation between internationalization and innovation: however, only about 13% of EU SMEs are active in markets outside the EU.[2] In Italy SMEs are a prevailing number of enterprises (over 99%) as in EU, often very small enterprises (about three employees), but with a contribution to employment greater than 80%.

All these data show a high propensity to entrepreneurship in several European countries, as well as a strong individualism, which could be motivated by the historical evolution of local regions and areas. Recent social-historical analyses in some industrial districts in North-East Italy show that the founders of SMEs (reference is made to persons born in the second half of the nineteenth century) were characterized by a strong ethical individualism, with adhesion to local values and customs, with a prevailing "craftsmanship-derived" culture, a refusal of management-devoted persons and a strong overlapping between enterprise and family. This individualistic approach to small enterprise creation, indeed, comes from a tradition dated the seventeenth century, when initial capitalist activities originated in the small principalities and counties in which North Italy was subdivided at that time. The stimulus to invest in manufacture and commerce came

[1] European Cluster Memorandum, July 2007, re: www.proinno.europe.eu/NWEV/

[2] "Internationally active SMEs yield better results", Brussels, 6 July 2010, Report of the Commission Vice-President Antonio Tajani, responsible for Entrepreneurship and Industry, re:

from some princes, pushed by the military necessity of their own small countries. From this followed prohibitions on the export of raw materials (wood, iron, silk) and prescriptions to establish plants inside (foundries, textile, and furniture firms) and employ local personnel.[3]

Similar situations occurred in old Germany and Holland, and also in other European countries, even if in different epochs and different contexts. So, it could be argued that an historical thrust to entrepreneurship gave rise to a number of local agglomerations of SMEs, which became the real "engine" of the regional development, till now being the keystone of the European regions with a higher industrial level.

The recent globalization of the markets of goods and the large disequilibrium between the labor markets of the "Old Europe" countries, on one hand, and of the "emerging countries", among which China, India and the "Asian Tigers", on the other, is compelling a large part of European SMEs to be no more competitive in terms of labor cost and goods prices.

During this last decade the European Commission has gradually perceived this new situation and has stimulated studies and research on what should be the real *antidote* to this crisis: the development of more and more profitable SMEs aggregations, in the form of either "clusters" or "competitive poles" or "industrial districts". A large set of qualified researchers could be mentioned to support this point. In 1890, the British economist Alfred Marshall[4] gave a first discussion on geographic concentrations of specialized industrial activities. His studies showed that the presence of several SMEs in a common area reinforce themselves by attracting complementary activities at the various stages of the supply chain. They can also create a pool of specialized labor, which could support the diffusion of knowledge among firms. SMEs of a similar type might support trade or professional associations. These can maintain and upgrade standards in skills and products, lobby local or regional governments for investment in appropriate public goods or support collective marketing activities.

As studied by Michael Porter in his 1990 book "*The Competitive Advantage of Nations*", the geographical concentration of SME clusters and districts could affect the local industrial competitiveness in three ways. First, it reduces costs: firms can operate with lower levels of stock because of the local presence of specialized suppliers, and they can have access to specialized skills, often also aided by local training providers. Second, it could increase the propensity to innovation by facilitating interaction and dissemination of knowledge. Third, it can promote new business formation through creation of new enterprises which can find lower barriers to entry than in other localities.

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[3] A note from L. Bulferetti, Problems of Sixteen Century, in "*Itinerari*", n. 22–23–24, Dec. 1956 (in Italian).

[4] Marshall, Alfred (1920). *Principles of Economics* (Revised Edition ed.). London: Macmillan; reprinted by Prometheus Books. ISBN 1573921408.

However, the ability of a region to either generate or support SME clusters and districts greatly depends also on the government aids. National and—mainly—regional governments are really important, because of the influence they have over the ambient conditions—especially local diffused industrial knowledge and personnel skills—and the regulatory and legal environment.

This is the reason why, to effectively promote the role of employment fly-wheel played by SME clusters in the EU, a prompt application of political actions planned by the "Small Business Act (SBA) for Europe"[5] is expected soon. The crucial action is to force a strong cooperation between the European Commission and the national and regional governments. Some work has already been done, and some other is going to be. As written in the presentation of the European Cluster Conference 2010,[6] "*the future competitiveness of the European Union will depend on its ability to renew its industry base and to strengthen the thriving services sector towards a more competitive and greener economy based on knowledge and innovation. To achieve this, Europe needs more world-class clusters, which are hotbeds for turning innovative ideas into new products and services and for providing a particular fertile environment for new business formation that creates innovation, growth and jobs. A more strategic approach is needed that builds upon existing efforts and explores new cluster concepts for establishing the right framework conditions for new and innovative industries*." In this light, some questions appear to be crucial:

- What cluster policies (instruments and tools) are needed to foster modern industries in line with the new nature of innovation?
- What are the enabling framework conditions for the development of strong clusters in innovative industries?
- What actions are needed to raise the excellence of cluster policies in order to facilitate more world-class clusters in Europe?

The scope of this "instant book" cannot surely cover all these very crucial questions. However, it aims to give to managers some ideas and concepts to approach the main aspects concerning the organization of clusters and districts in some EU countries. It also aims to give to SME managers, a "handbook" of criteria to understand when and why to become a partner in a SME cluster can be profitable for their enterprise, and which procedures must be known to be a collaborative member of the cluster itself. To this aim, an overview of some SME networks/clusters in Europe and outside will allow significant comparison of their respective strength and weakness.

Agostino Villa

P.S. The idea of this "instant book" has been suggested and promoted by the International Association EVI—The "*European Virtual Institute on Innovation in Industrial Supply Chains and Logistic Networks*", an international non-profit

[5] Small Business Act for Europe, EC Doc. COM (2008)394, June 6th 2008.

[6] European Cluster Conference 2010, July 2010, re: www.europe.innova.eu.

association of universities and research institutions, established as a "spin-off" of the project *CODESNET*—Collaborative Demand and Supply Networks, funded by the European Commission in the 6th FP. The EVI Association is located at the Politecnico di Torino, corso Duca degli Abruzzi 24, I-10129 Torino (Italy), Director Prof. A. Villa.

Contents

Chapter 1
Organization in SME Networks

Dominik T. Matt and Peter Ohlhausen

Abstract Sustainable economic development is based on a foundation of innovative activity (development of new products and processes), entrepreneurship (converting innovation into economic activity), and industry clusters (networks of supporting markets, services, and skilled labor). The purpose of this chapter is to demonstrate how network organizations of small and medium sized enterprises (SME) can contribute to economic growth. It is concluded that network organizations are a very suitable form to sustain continuous business growth without losing the advantages of the high adaptability of a typical SME. A special focus will be given to a new concept, which proposes sustainable business growth in networks based on so called 'core competence cells'. It allows an organization to flexibly adapt to changing environmental conditions, and thus promote sustainable business growth within an organizational network.

1.1 Introduction

Micro, small, and medium-sized enterprises are the backbone of Europe's economy and the key to Europe's competitiveness. They make up 99% of all enterprises in the EU25, representing about 25 million companies, employing almost 95 million people. As an essential source of entrepreneurial spirit and innovation,

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these enterprises have proved several times to play an important role in compensating for job losses in the years of general economic depression (Matt 2007). Thus, it seems important to identify the factors for sustainable success of small and medium enterprises (SMEs). In an effort to ensure such small businesses' success, owners (entrepreneurs) will have to resort to forms of collaboration or cooperation. This is most probably the only means by which countries can make sure that SME's add value and stimulate economic growth (Matt 2008).

However, small and medium enterprises (SMEs) are facing numerous challenges, i.e., to develop innovative products and services on faster cycle time, to integrate across diverse technologies in producing and servicing, and to compete with new competitors crossing not only geographical but also industry borders. Hence, organizations are facing increasing pressure to do a better job on gaining access to new knowledge in their business environment while at the same time leveraging their existing knowledge within the boundaries of the firm (Teigland 2000). In addition to this, the rapid technological and societal changes of the world have created new demands for networks.

A network is a remarkable developmental environment, especially for SMEs (Iskanius 2006). It enables each network partner to better access sources of raw materials, customers, new technologies, and innovation, etc. Networking also allows small firms to combine the advantages of smaller scale and greater flexibility with economies of scale and scope in larger markets—regional, national, and global. Above all, SMEs via networks are able to get a better and more comprehensive view of the market demand and thus help to explore new business opportunities. A quite complete list of advantages and disadvantages of networking of SMEs can be found in Table 1.1

SMEs are becoming more involved in international strategic alliances and joint ventures, both alone and in SME groups. Larger multinationals are partnering with smaller firms with technological advantages to economize on R&D, minimize the lead-time for new products, and serve emerging markets (OECD 2000). Typically, SME manufacturers are subcontracting companies that produce components or products for one or a few focal customers. If the SMEs are competitive in their production activities, their reputation will rise, and this will provide new opportunities to make new customer relationships. In addition, there can be some niche market segments that are not attractive for large enterprises. These niche market segments can be very interesting for a small firm. According to Cambell (1997), SMEs should concentrate on a specialization or niche strategy. A very important prerequisite to do this successfully is to focus on core competencies and to abandon/outsource those activities which can be considered non-core business.

The explanation for this is easy and plausible at the same time. Entrepreneurship can be defined as the opportunity to self-determine the own economic success. The perspectives of economic success and independence, stimulate to run a certain entrepreneurial risk (Matt 2008).

Therefore it is important to know the levers for increasing a company's success. In other words: a product or service offer will only be successful if it creates best

Table 1.1 Advantages and disadvantages of networking for SMEs

Advantages	Disadvantages
More effective utilization of capacity	Varying use of capacity
Decreasing costs per unit	Varying delivery time
Increase of flexibility and volatility of production processes	Inflexibility of the production processes quality problems
Increase of reliability	Difficulties in cost management
More effective management of material flow and inventory	Difficulties in management of material flow
	Difficulties in management of information flow
R&D knowledge	Insufficient project management skills
Wider product and service offerings	Other information barriers in production processes
New innovation and business possibilities	Lack/change of responsible persons
Better quality of products and processes	Excessive competition
Better human resources focusing on the SMEs' own core competence	Poor information technology facilities
	IT incompatibility problems between companies
Better knowledge	Lack of trust
Development of the customer demand production	Unfair contract terms and short-term contracts
Better focusing of investments	Negative attitude of the personnel
Greater visibility of production processes	Problems in the relationships of personnel
Environmental concern about products and production	Difficult terms of agreement
	Poor internationalization abilities
Easier to recruit staff	
Easier to become internationalized	
Easier to get finances	
Financial costs decrease	

Confederation of Finnish Industry and Employers (2004)

customer value from the buyer's perspective. The probability to achieve this target increases if a company strictly focuses on its core competences (Prahalad and Hamel 1990). Thus, core competences can be simply defined as competences that create a high customer benefit, assure competitive advantages, and are difficult to imitate.

To concentrate on core competences means to promote those activities that help to achieve the company targets and to create internal know–how (Javidan 1998).

1.2 Networks of Core Competence Cells: The 3C Approach

There are many different definitions and types of core competences, see for example (Selznick 1957; Ansoff 1965; Stevenson 1976; Porter 1985). Nevertheless, a general classification scheme can be identified:

Basically, the variety of core competences types can be condensed to the following basic typologies: 'perform a service', 'produce', and 'sell a product or service' (Matt 2007).

The example of a medium sized company helps to illustrate this (Matt 2007): a producer (PR) of plastic components serves two different market segments: the automotive supplier industry as a tier 3 supplier and electric wholesalers as a brand PR for isolated tools and devices for the electrical engineering. The core competences include: a sales channel for electric wholesalers (type 1), an R&D department which offers also services to third parties (type 2) and an efficient injection moulding plant producing high quality at competitive prices (type 3).

This example and the analysis of different other business cases show that a company's core competences can be derived from a mix of the three basis typologies. There are different scientific publications dealing with organizational units focused on autonomous, elementary units of production, cooperating in temporary networks based on customer-oriented, directly linked, smallest autonomous business units called competence cells, see for example (Teich 2003; Neugebauer et al. 2004; Ivanov 2006; Müller et al. 2006; Matt 2007). In accordance with previous publications, in the following, a different definition is introduced:

An organizational unit which concentrates exactly on one core competence classified within one of these three basic typologies is called 'core competence cell' or '3C'.

Best prospects for a sustainable growth have networks with exactly one 3C or a mini-network of 3C's at their nodes (Fig. 1.1). In this context, it is insignificant if a 3C is represented by a legally independent company or by an autonomous business unit. According to the previously defined basic core competence typologies, three types of network cells can be differentiated: the 'dealer (DL)', the 'service provider (SP)', and the 'producer (PR)'.

The 3C approach assumes that a core competence cell has best chances to grow within a network if it is not limited in its own development by the consideration of own activities' effects and consequences, on the development of other competence cells. In other words: a network cell that is conditioned in its development by other network partners, risks losing competitiveness.

In terms of business contents, differentiation within a 3C might require a cell division; in such a case, an existing 3C unit splits off a new autonomous unit

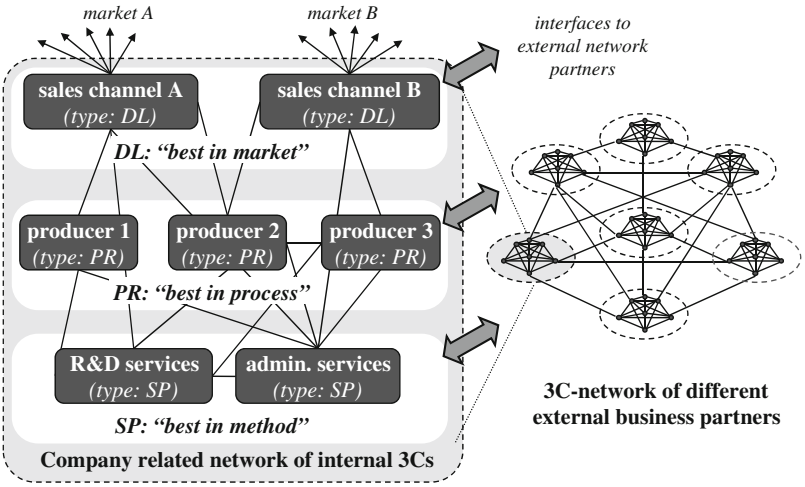

Fig. 1.1 Concept of 3C networks (Matt 2007)

with the same 'genotype', i.e., with the same core competence type, which continues to develop autonomously (Matt 2007). The reason for this usually lies in a strategically different orientation of the 'spin-off'. For example, an industrial engineering consultancy starts to offer also product design besides production engineering services. At a certain point in time, it makes sense to start a spin off with a clear new focus on product design within the new core competence cell in order to create a clearer identity and even a better market visibility.

However, in some cases also an increase in the internal organizational complexity over time can be a trigger for a cell division. Thus, a core competence cell ideally maintains a small structure because the systematic reduction of the time-dependent combinatorial complexity leads to a cell division (Matt 2010). Summarizing, the 3C approach offers a set of criteria for a good design of SME networks; every network partner concentrates on own core competences, ideally within one of the three basic core competence typologies. Although being part of a collaboration network, it maintains its autonomy. When growing, every cell ideally observes periodically, its internal organizational complexity and own strategic orientation, in order to identify the right moment for a cell division. This way, it can grow with and within the network and use the advantages of a large platform without losing the flexibility and agility of a small structure. The approach is suitable for the organizational network design of legally independent partners as well as for the organizational development of single business units or profit centers of a just one company, for example in the context of a company's organizational design in geographically distributed co-operative production (Matt 2010).

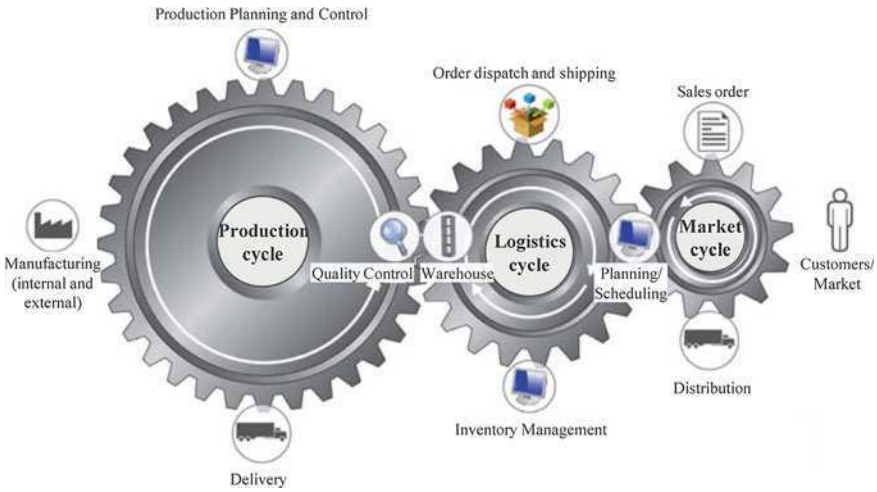

Fig. 1.2 Three cycles based on the three core competence base typologies characterize a typical supply chain—they rotate with different rotational speed (Matt 2009; see also Matt 2006)

1.2.1 Supply Network Design with the 3C Approach

So far, the theoretical basics of the 3C approach have been described. However, practical application needs a design procedure which shall be introduced within this section.

1.2.1.1 Design Procedure

Starting from the experiences of several organization projects in internationally working SMEs, the following explanation model has been developed (Fig. 1.2).

The three gear wheels shown in Fig. 1.1 rotate with different rotation speed's. The fastest is the market cycle; it has to react quickly to market requirements and refers to the basic core competence 'sell a product or service'. Thus, the central measure for success is the sales margin. To be successful, it has to (Matt 2007):

- Focus on the most profitable market segments.
- Build a strong sales channel and push sales.
- Select reliable and cost effective suppliers.

Production is a transformation process that produces storable goods from raw materials or semi-finished products using energy, workforce, and operational resources.

A PR aims at the minimization of manufacturing costs and the optimization of flexibility. This can be obtained only by process leadership regarding production

efficiency, quality, and organizational flexibility. Successful PRs introduce (Matt 2007):

- Suitable and modern production technologies
- New methods and techniques of production organization
- Procedures for the continuous improvement of efficiency, quality, and cost reduction

However, the production cycle is usually much slower than the market cycle. Thus, it is synchronized with the market cycle via a central gear wheel, the so called 'logistics cycle'. The logistics cycle is a typical application of the base profile of a 'SP'. In contrast to products, services are not storable or transferable and are related to persons, and their technical, and interpersonal skills. The target system of a successful SP comprises (Matt 2007).

- Employ only the best and most motivated collaborators.
- Train his staff continuously at the highest possible level.
- Use best practice methods and information technology support.

1.2.1.2 Example 1: Automotive Supplier Industry

In the following, one of several industrial cases will be described in which the above described methodology has been successfully proven (Matt 2010).

The company is a medium sized automotive supplier of aluminum die casting parts. Its strategic positioning is differentiation by quality and technology, helped the company already in recent years to successfully cope with economic ups and downs—even in the latest global economic crisis. Globalization in the automotive industry forced the company to follow its customers and thus create a geographically distributed production. However, due to the complexity of management of these different sites and the related increase of transaction costs, a re-organization project was launched with the objective to create a lean and efficient network organization structure based on process orientation.

In a total of four workshops with senior management, the new network organization was developed based on the guidelines offered by the 3C approach.

First, an actual complete list of strategic success factors for the company was developed and assigned to the three different base core competence typologies DL, PR and SP. Within the base types, sub-differentiation in the SP area was necessary due to very different competence requirements within the SP type. Finally, four so-called network modules were created (Fig. 1.3) which can be assembled to build the different company sites.

In the next step, the necessities of the different locations based on customer and market demand, and on process logic were defined. Consequently, the different modules were assigned to the locations (Fig. 1.4).

Of course, detailed work had to be done to define the next levels of hierarchy. This can be easily done using the well known approach of process orientation—also

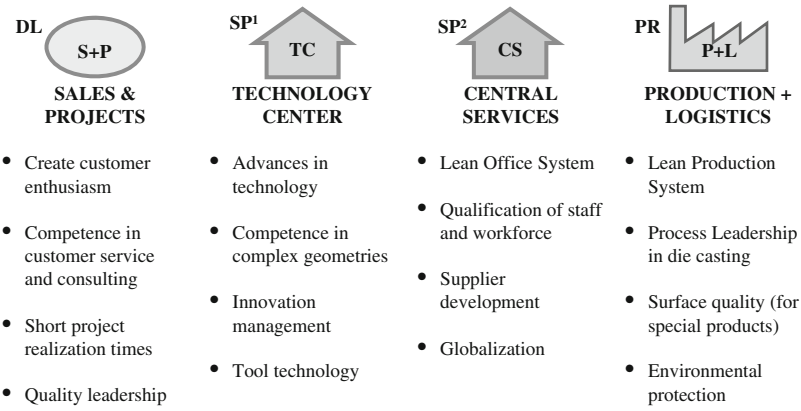

Fig. 1.3 The four network modules with relative success factors defined by management

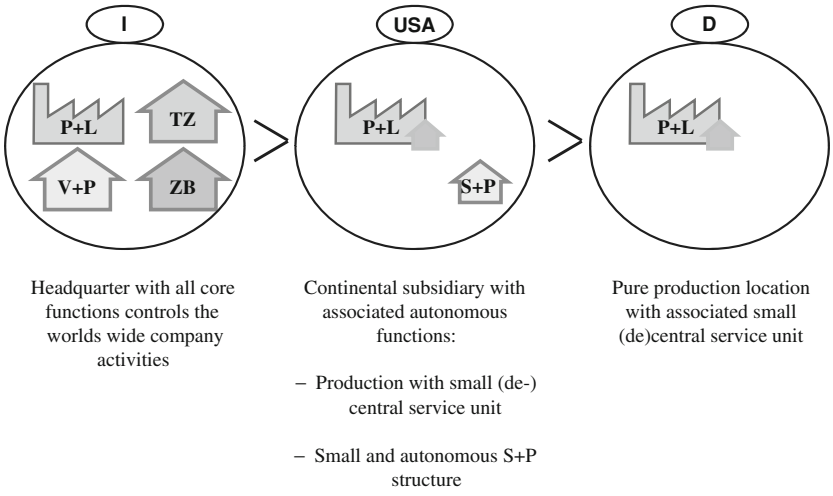

Fig. 1.4 Organizational site configuration in 3C logic

applied in this specific case. However, this does not enter into the focus of this paper that concentrates on organizational design in geographically distributed co-operative production networks.

Going back to the results shown in Fig. 1.4, it can be stated that the company now has a development logic on hand that efficiently helps senior management in decisions regarding the organizational design of new plant sites or subsidiaries. The experiences made so far are more than positive; feedback from company after the first year of implementation shows the validity of the approach.

1.2.1.3 Example 2: Bathroom Accessories Industry

The following example, based on a long-term study and cited from (Matt 2007), is suitable for the practical demonstration of the successful establishment of a 3C network structure between a set of different companies that gain synergy effects from the network collaboration. The example starts from a single company founded about 30 years ago as a 'one-man-show'. The founder started it literally in a garage with production and sales of the self-designed shower cabins.

Having identified the problem that the dependence from only one person causes a stagnation of growth, the founder decided to involve a companion who brought besides financial support, also a good sales network. In a next step, a young engineer was enrolled with the product design. He also became a companion some years later. Production was enforced by further employees and managed by the founder himself. Then, some years later, the companion's retirement (sales) from the operative business led to the organizational re-structuring and the introduction of an enlarged functional structure. After this organizational change, the shower cabin PR grew continuously for about 7 years, even during phases of economic depression. Suddenly, growth stagnated. The entrepreneurial reaction consisted in the attempt of 'buying' growth by differentiation, and investments in other companies working in the bathroom sector. But these activities were not really successful as the 'new buys' maintained their old organizational structure and brought neither cost reductions through synergies nor economies of scale. On the contrary, due to an increasing necessity of coordination, a central holding was introduced, creating even more costs and complexity. The effects; total revenue increased, but profitability decreased.

Thus, the entrepreneur decided to introduce the 3C concept to re-start economic growth. First, for the various market accesses, different sales channels with respective 'market cycles' were defined: one for the three-stage sales channel (wholesalers), a second for the two-stage sales channel (do-it-yourself markets), and another one for the project market (construction industry). As a kind of broker, the market cycles offer customer orders to the whole company network. In addition, two SPs were created to perform services for network internal and external customers: SP 1 offers central R&D services to all network partners; SP 2 renders general services like controlling, accounting, and administrative services. Furthermore, different PRs were defined: PR 1 supplies metal and plastic components as semi-finished products to PR 2, 3, 4 and to external customers, as well as finished goods to the market cycles 2 and 3. PR 2 manufactures bathroom accessories on customer demand, while PR 3 manufactures standard bathroom accessories. Both serve the three sales channels. Finally, PR 4 produces prefabricated bathroom pods for the project market. The strong orientation towards new materials in this market might lead in future to a further cell division. The single core competence cells are acting autonomously, some as profit centres, most of them as legally independent companies.

In 2009, this 'enterprise network' offered jobs for 260 employees and generated consolidated yearly revenue of about 75 million euro. According to the new EU

definition, this company would already fall out of the SME range. In fact, the company maintained the medium sized structure through a network of collaborating, autonomous, and highly profitable SMEs. For the next 3 years, further growth is planned within the 3C structure.

1.2.1.4 Outlook: 'build4future': How to Organize Innovation in Networks

The following case is in preparation and not realized yet. Within the research project 'build4future' a group of 12 non-concurring Italian SMEs in the construction sector (e.g. window manufacturer, façade industry, prefabricated bathroom manufacturer, prefabricated concrete component manufacturer, etc.) are going to work together with a group of researchers of the Free University of Bolzano, the just founded first Italian Fraunhofer subsidiary, the Fraunhofer Innovation Engineering Centre (IEC) Bolzano, and the Klimahaus-Agency to develop and test a SME construction network for the industrialized modular construction of individually planned buildings on the basis of the 3C approach. The objective is to set up an industrialized and efficiently coordinated process in a network of SMEs that enables to reduce the total construction costs by 20–30%, to further enhance quality, to develop a shared marketing and sales platform, and thus enforce the market power, and to establish a shared cross-sectional innovation process. Combining the strengths of small structures (flexibility, customer focus) with those of large enterprises (scale effects, resources for innovation), the expected results are to launch a best practice model that sets new milestones in competitiveness.

In this context, experiences made by the German sister institute of Fraunhofer IEC Bolzano, the Fraunhofer IAO in Stuttgart, in various studies and research projects regarding innovation and technology management in distributed structures, will be considered. These aspects will be described in the following sections.

1.3 Innovation Network Design

1.3.1 The Future of Innovation Management: Paradigm Shift

Enterprises which want to secure their future by innovative services need to prepare themselves for the rhythm and paradigm shift. Furthermore they have to adjust their innovation management to new challenges and requests. Everyone is talking about 'Open Innovation' and 'Collaborative Innovation', but to gain a profit from it companies, need to implement successful innovation management and good networks. That is the only way to successfully recognize, use, and apply internal and external sources of innovation. To master the challenges and complexity, companies have to undergo organizational changes. Sustainable

innovation management means that the conditions are made for 'Breakthrough-Innovation' as well as for 'Incremental Innovation'.

1.3.2 New Business- and Management Models, Structures and Processes for Linked Innovation

Creating innovation networks or participating in them only makes sense if enterprises gain a profit from it. Consequently, one main focus is set on the design of business- and management models. Next to 'Elite Circles' 'Innovation Communities' with an unlimited number of participants who may be unknown to the enterprise could come up with faster and improved solutions. Platforms which integrate user or developer and platforms which enable complementary innovations gain in importance.

1.3.3 Intermediary, Broker and Open Innovation Platforms

The paradigm shift brings up new players, for example innovation broker and advisor. Regional organizations are given the opportunity to not just inform others but also to actively support different players with their innovation. Special emphasis is laid on design of IT supported innovation platforms and consideration of legal framework.

1.3.4 Management Model of Innovation Network Design

To manage tasks and cooperation goals, player and employees invest their knowledge in the innovation process of a company or a product development. Complex tasks are solved in cross-company teams and under consideration of core competencies. To define and pursue common goals, multiple coordination processes are necessary.

The model by Ganz and Warschat is limited to the singular knowledge integration and leaves other aspects like the development of new knowledge or the modification of current knowledge, out of consideration. Integration of knowledge is a condition to enable co-operations. Based on that, players need to be supported by additional elements (see Fig. 1.5), to be equal to the goals of the cooperation. Additional elements could be problem solving strategies and procedures. A good cooperation with the partner company is crucial, that includes exchange and transfer of knowledge, combination of competencies, etc. (Ohlhausen et al. 2008).

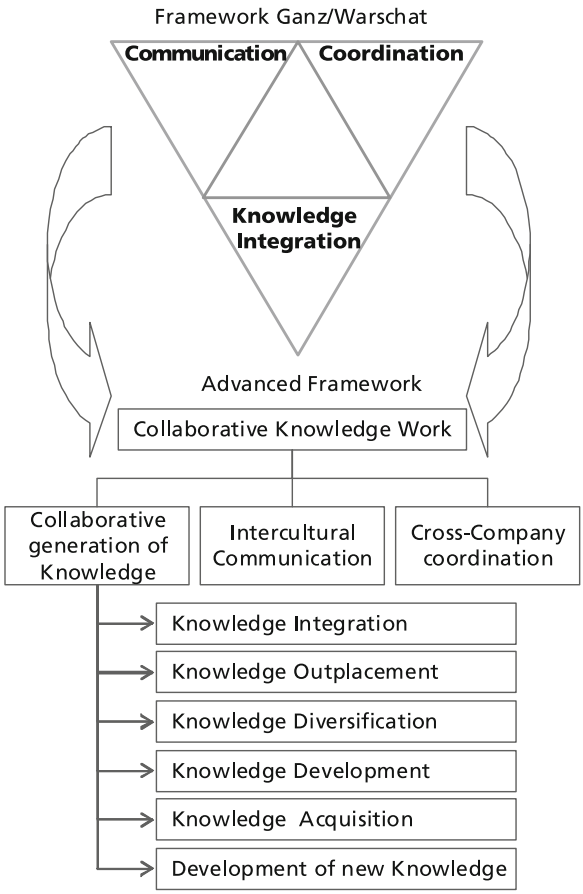

Fig. 1.5 Enhancement of the cooperation model of Ganz and Warschat

Common goals and performance measurements have a positive effect on the productivity of a team. Social skills are especially important in a team. With good social skills, it is easier to solve problems and make decisions. They also improve the communication within the team. Additionally, a focus should be set on the intercultural competencies (Luckmann 1992).

Furthermore, the complexity of products and processes makes it necessary to distribute knowledge among many people. These knowledge carrier's need to be integrated in the working environment. Hence, the relevant knowledge carriers need to be able to quickly connect with people in different fields of expertise or people who work in partner companies. Next to the knowledge, coordinative and communicative conditions are crucial when working with employees from different companies (Ganz and Hermann 1999).

Antipathy and trust influence success or failure of a cooperation.

This leads to the conclusion that co-operation between partner companies can be reduced to the cooperation and interaction between the players.

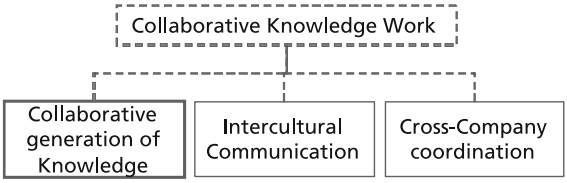

Fig. 1.6 Design element 'life cycle of co-operations'

The result of which are three relevant concepts of design (see Fig. 1.6). Each one on its own does not reflect the whole. They have to be seen in connection with each other.

- Intercultural communication: First of all and very simplified, this means the exchange of information. Besides technical possibilities intercultural factors which are often underestimated, play an important role.
- Cross-Company coordination: Coordination arranges single activities into a logical context, which is important for the decision-making-process. Coordination takes the integration of single steps and the harmonization of these into account.
- Collaborative generation of knowledge: The extend of knowledge in a company results from the interaction between employees and co-workers. Involved companies jointly need to harmonize, integrate, developed, and use this knowledge. Only companies which 'speak the same language' can walk together in the same direction.

These sub-processes and their organization enable a trustworthy cooperation between involved companies and employees. The sub-processes on its own just describe one part of the whole. A combination will lead to a comprehensive solution which fulfils the demands. Necessary tools and processes have to fulfil the requests of the players as well as the objectives of the cooperation. A sufficient balance of both sides can result in a 'win–win-situation' within the cooperation.

1.3.5 Design Element: Intercultural Communication

Between the cooperation partner's continuous mutual communication (exchange of information, data, and knowledge) throughout the whole cooperation is crucial (see Fig. 1.7). The aim of communication is the creation of common knowledge. Regarding the starting position, a change has to be measurable. That means that added value should be perceptible for at least one partner, especially during product development communication processes that alter due to rapidly changing basic conditions (e.g. customer requirements).

Horizontal Communication describes communication between people working in different companies but on the hierarchical level. In that case, communication is used for a collaborative generation of knowledge.

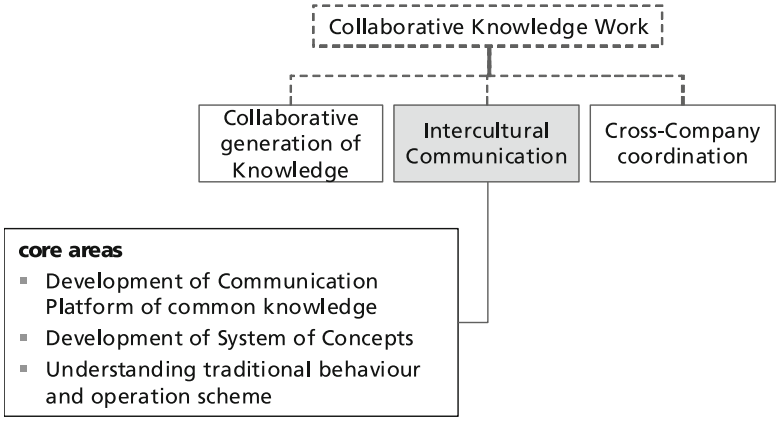

Fig. 1.7 Design element 'intercultural communication'

Without communication between player's coordination and collaborative generation of knowledge is not possible.

While designing communication relations, it is advantageous to organize face-to-face meetings. Due to geographical distance this is not always possible. Support by different media e.g. video conferences is of great help. These tools are used to its full extend only if both partner already built up mutual trust which can only be gained by 'face-to-face' communication at the beginning. Otherwise, these tools are not efficiently usable. Furthermore, intercultural differences play an important role regarding communication. Varying opinions relating to avoidance of uncertainty, masculinity versus femininity as well as collectivism versus individualism are of great significance.

In opposition to previous company experiences, dynamic environment enforces a higher communication density, particularly in product development cooperation, when, for instance, agreements during team meetings are quickly revised and spontaneous voting on the future development process becomes necessary. It is necessary to change communication behavior between partners and switch from being 'obligated to collect' to 'being obligated to deliver'. Continuous progress of knowledge and time pressure during development demands quick feedback (obligation to deliver), plan variances occur.

1.3.6 Design Element: Cross-Company Coordination

Coordination deals with interconnections between activities. It integrates and harmonizes every partners' individual contributions, aligning it to superior cooperation targets. At the same time, coordination makes sure that tasks are segmented and differentiated (using a broader understanding of the term coordination).

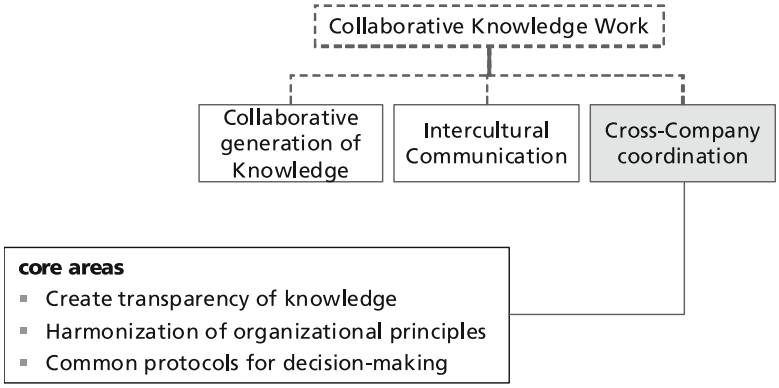

Fig. 1.8 Design element 'cross-company coordination'

Most of the time, this is given through artefacts, still it gives sufficient leeway to actively designing it. Besides the analysis of knowledge fields and the systematic classification, one of the coordination's main tasks is to create transparency between existing knowledge fields and subtasks of the cooperation project. A clear definition and the communication of responsibilities and decision routes are crucial in enabling efficient collaboration. Regarding cross-national cooperation, it is beneficial to take intercultural circumstances into account.

To some extend, a facilitator is necessary to connect knowledge carriers from different companies, when they meet for the first time. A facilitator's job is to integrate and align 'languages and definitions' enabling combination and transparency. This is possible especially by the use of personal contacts and an appropriate information and communication (ICT) environment.

In this context, it is worth mentioning that companies face special challenges regarding the coordination of collaboration in cooperative development processes (Bullinger 1997). Especially when developing new products or services, and dealing with a dynamic environment, planning ability of subsequent work steps is limited. To some extend, agreements made at team meetings are obsolete immediately afterwards, due to new findings of a partner. Such cooperation requires all partners to act and react flexibly and to further design relations between them (see Fig. 1.8).

1.3.7 Design Element: Collaborative Generation of Knowledge

The task of generating knowledge can be divided in several sub-processes (see Fig. 1.6). In order to collaborate successfully, at least partial integration of the partners' knowledge is crucial (see Fig. 1.9). Feeling substantial time pressure, the cooperating players (experts) have to quickly develop a basic understanding about

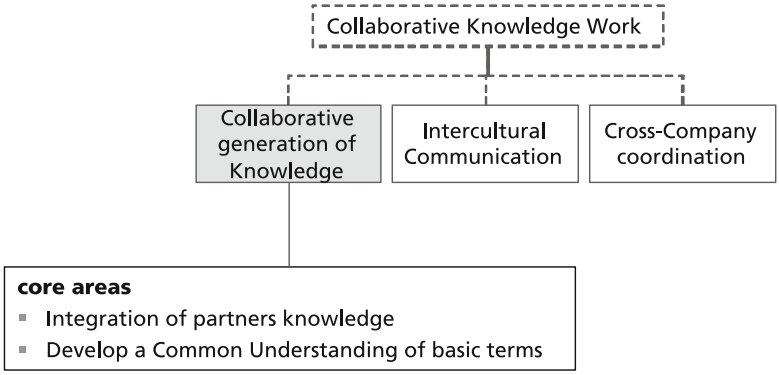

Fig. 1.9 Design element 'Collaborative generation of knowledge'

work content and process, as well as the partners' mindset and language. Problem statements and decisions cannot be communicated without a shared understanding. Therefore, integration of knowledge is the basis for communication and coordination. Without a common understanding of basic terms and their impact, no information can be transported through communication and a coordination of work content is impossible.

When designing knowledge integration, one has to consider that a complete integration requires time and resources. Therefore the cost benefit ratio for each knowledge field, e.g. calculation sequences, material applications, and knowledge carriers, has to be assessed.

Case studies show that, because of the reasons mentioned above, the first cooperation phase substantially influences future progress of a newly formed team. In this case, integration of knowledge is the crucial factor besides communication and coordination.

The additional sub-processes (knowledge outplacement, diversification, enhancement, acquisition, and redevelopment) all build on knowledge integration (see Fig. 1.6). In order to execute them, a comprehensive integration of all significant knowledge bases with participating companies is necessary. Only by aligning existing knowledge, the corresponding sub-processes of knowledge modification are established efficiently. In addition, involved employees need to know about basic elements of every cooperation partner in order to generate new artefacts and avoid redevelopment of already existing knowledge. The design of the sub-processes of knowledge modification is necessary and leads to opening up and developing of new knowledge fields conjointly. As long as sufficient coordination is provided, high effectiveness is ensured. It is the executive management's job to select and process the right knowledge fields. Implementation occurs within cross company working groups and project teams (Ohlhausen et al. 2002).

Concluding, one specific attribute of knowledge modification, the dynamic character of product's developed, caused by turbulent markets and technology

development (e.g. miniaturisation), is particularly relevant. Consequences are an active design of communication channels, mediums, as well as the efficient coordination of all corresponding tasks.

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Chapter 2
Cooperative Agreements for SME Network Organization

Agostino Villa and Teresa Taurino

Abstract Present chapter provides a practical overview about the most common types of SME groupings in a number of European countries, and about the agreements established among the network's participants, to the aim of highlighting which main cooperation aspects have to be approached in designing a new cluster, and which collaboration rules have to be stated in order to build robust collaboration and avoid conflicts. Indeed, internal conflicts developing inside a SME cluster just formed to appear as the most dangerous of the problems which could affect these organizations: they could even lead to the cluster explosion.

2.1 Introduction

Groups of SMEs have been developed in different European countries, following different clustering approaches based on the main features of the local industrial systems and on the historical evolution of the regions. It is possible to recognize three main clustering pathways:

1. Spontaneous agglomeration of groups of SMEs, where SMEs belong to the same geographic area, i.e. Italian industry districts and UK clusters.
2. Groups formed to develop a common project in a distinctive industrial sector under the incentive of the local or national government, as for poles of competitiveness in France or scientific parks in Greece.

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3. Groups developed from coalescence of several SMEs around a leader firm, i.e. Japanese and German clusters and supply chains.

Depending on the nature of the group, there is often organization whose task is to preside over interactions among SMEs and to exhibit the group as an individual partner during negotiations. The organization follows specific rules and models:

- Cooperation rules, often reducing to an informal collaboration, in the districts.
- Aggregate planning rules in the case of poles.
- Industrial client–server management rules, in the supply chains.

Different countries present a number of preferences for specific- and country-related models that allow to make explicit, all of the models illustrated above. Among the many countries a selection of some cases have been made in order to present the maximum variability of applications.

2.2 Italian Industrial District: Is there any Evolution in the Near Future?

Typical Italian industrial districts, even if significantly different in their history and past evolution, have been originated from an artisan tradition as those developed in the ancient guilds born in the renaissance towns among the artisans working in the same commercial sector, as jewellery, clothing, and the masons' corporation. This initial status gradually evolved to an industrial reality only in the second half of the last century.

As from the official data of the last census in 2001, industrial districts generated a global production amount responsible for about 27% of the GNP. They cover 44% of the Italian export of manufactured products: value raises up to two-third of textile-fashion export, and over 50% of manufacturing mechanical machines. Accounting for the Marshall model (Markusen 1996), the typical Italian industrial district, has revealed to be an efficient alternative to the large-scale concentrated enterprise because it consists of a 'protected' environment for the SMEs, but maintaining advantages of the Taylorism-based division of work. It will be shown in the following how a district could assure these two complementary beneficial effects to the partner firms. A preliminary consideration should, however, be drawn: each time a production sequence has to be decided in a district, different phases should be implemented by different SMEs, which indeed are pushed to specialize their respective plants such as to become complementary as possible to the other SMEs as well as useful for the actual impact of the whole district in the market. This type of informal involvement of each SME in contributing to the district reinforcement could be considered as the 'character of the cooperation'.

A social history of Italian industrial districts—now only partially written for a few sites and personalities (Henzler 1994)—could give outlines along which local communities gradually got a precise self-consciousness of their specific district

identity as an organized society of autonomous agents, each one having to agree upon a statute and a governance (Villa and Antonelli 2008).

Looking at the repository of European industry networks collected during the development of the CODESNET project (Antonelli and Villa 2007), with attention to Italian industrial districts, they can be seen as complex systems composed by networked organizations of SMEs, and could be characterized as a cognitive, relational, and competitive environment whose internal vitality and external effectiveness depend on agents (the partner SMEs), each one with proper individual features: enterprises of different nature and dimensions, but also service agencies, research centers, and sometime schools. As a common feature, relations among enterprises in the network appear to be clearly 'regulated' (often, informally, but always based on trust) by interactive communication and cooperation: besides reciprocal trust, district agreements are the mechanisms by which the complex network of individual agents could be managed.

2.2.1 Rules and Laws for SME District Organization

Even if Italian districts are industrial bodies that originated by artisan experience and local groupings, they first appeared in the Italian legislation only in 1991 (law n. 317/1991), defined as 'local territorial areas characterized by high *concentration* of SMEs, (being the SME concentration referred to the rate of enterprises over the population in the area) and the *production specialization*.

This same national law states quantitative criteria according to which a territorial area could be officially recognized as 'industrial district', among which:

- The industrialization rate, that is the rate of industrial personnel over the population of the area, to be greater than the national average value of at least 30%;
- The population specialization, same as above but referred to personnel employed in the SME district, with same quantitative constraint;
- The incidence of personnel in the district SMEs over the number of workers in the same sector in the area, to be greater than 50%.

This first attempt to codify some 'district identification criteria' is a proof of the original nature of these same bodies. The word 'district' is associated to a territory, and the attribute 'industrial' is an empirical concept based on social-economic indicators, to be collected over the area population (as in a census data collection). Indeed, the task of identifying the district area such as to define supports, both organizational and financial, has been assigned to the regional governments.

Soon, it appeared that to define a territorial area as an industrial district through quantitative identification indicators was a wrong approach because of the wide variety of different situations. This same defect prevented several regional governments from applying said criteria, thus slowing the district official recognition. On the other hand, the district evolution was going on in practice and was overall

recognized both at national and international levels. So, recent laws (law n. 266/2005 and law n. 33/2009) stated a new official definition of industrial districts which at the same time looks more general but also clearer than the previous one. Now this typical industrial body is defined as 'a free aggregation of enterprises with a territorial and functional organization, with the scope of growing the economic level in their own geographical area and industrial sector, and improving the organization and production effectiveness according to principles of vertical and horizontal reciprocal support, also through collaborative interactions and by means of enterprises syndicate'.

The approach of the more recent laws presents a significant difference from the past: an industrial district is originated by a free grouping of some enterprises, and the public administration should officially 'recognize' the existing enterprise group as a district upon request of the group itself. In practice, these laws identify the specific nature of an industrial district in terms of 'free aggregation' of enterprises, then a juridical body similar to an association of institutions with the scope of creating an industrial community. Then, there is no more territorial area characterized by some valued social/economic indicators, but lean organizations emerging from industrial projects. In order to support the district development, said laws prescribed some new interventions of regional governments, as fiscal facilities, bureaucratic supports through administrative counters in the district area, potential emissions of district bonds and so on.

The diffusion of districts characterized by weak organization, as the large number of existing districts mainly related to food sector, motivated the opportunity of codifying a new form of district named 'network' through the more recent law (laws No. 33/2009). By this law, an 'industrial network' is stated as a district where the cooperation among enterprises is based on a contract and possibly on the common property of some production means. Accounting for a group of enterprises located in the same area, i.e. SMEs belonging to a same network have to stipulate a coordination agreement stating reciprocal contractual constraints. A typical example, stated in the law n.5/2009, refers to a contract by which some enterprises agree to activate a common project such as to increase their respective innovation capacity and competitiveness. To reach their common goals, the enterprise belonging to the 'network' agree to have a coordination entity which can act for the network over any market, can negotiate the support of innovation programs with public officials, can operate to get risk capitals for new investments, and also use advertising tools and resources in order to promote goods produced by the network. Then, differently from the traditional district, the 'network' as a whole is equipped with a proper organizational structure and a proper patrimonial estate. With regard to any other operation, as for a district, the network functionality depends on the design capability of partners, on their ability to plan activities, rights and obligations of partners, rules to accept new partners inside, and to manage withdrawals in such a way to promote better cooperation, to prevent conflicts, and to exploit any potential strategic resource in the network (Fig. 2.1).

Fig. 2.1 Map of the districts in Italy
Source http://www.torinowireless.it

2.2.2 Where are Italian Districts Evolving to?

Looking at Italian districts on a general view, they have assured a high competitive capacity until the product markets where they operated remained almost static. This almost quiet situation made possible several experiences of progressive 'adaptive learning' by the most active personnel and SMEs, such that their technical knowledge was increased by synergy with the market slow evolution.

The social and economic changes occurring in the last two decades generated serious problems to the gradual reproduction of the district's ambience. Then, changes of the generation of operators and managers in some enterprises caused—and still is causing—severe threats for the survival of both individual enterprises and whole districts.

Districts indeed, even if representing an industrial organization model of success, cannot be seen as bodies 'naturally devoted' to a continuous development. Being complex aggregations of individuals, they require strong actions are of maintenance and frequent reviews of their success factors, if they are still surviving. So, a number of actions to be applied, as bravely and timely reorganization measures, should be considered from time to time:

- a first action that should be referred to, is the technological innovation, mainly concerning the utilization of new information and communication tools: these are the generators of better cooperation, and then better use of the district/network potential, that is the number and coordinated variety of industrial bodies and competences;
- a second action that should be referred to a new approach to the globalization of markets through a more courageous opening to international cooperation and projects: this second action could be the way to restart the experiences of 'adaptive learning', no more possible in a national static environment;
- a third action that should be refered to , is the launch of 'long-life learning' programs for the district personnel, at any level, by using international contacts, often supported by initiatives of the European Commission: one of the main defects of Italian industrial districts is just their 'fear' to participate in international consortia, perhaps owing to the fear of losing their even small technological property.

Those industrial aggregations which start to consider the three aforementioned reorganization measures are going to evolve towards a wider concept of either district or network, where enterprises are no more located in the same area but included in the same digital network and in the same unconstrained virtual space. That means industrial bodies open to larger interactions by which the opportunity and advantages of cooperation, assured by the special closeness in the past, will be guaranteed by the virtual closeness of ICTs.

2.3 The French Politics of the Competitiveness Clusters

The industrial system in France presents an original approach to the support of SME groupings, named 'program of competitiveness clusters' ('poles de competitivite'). A competitiveness cluster is an initiative that brings together companies, research cent and educational institutions in order to develop synergies and cooperative efforts.

Each competitiveness cluster is managed by a proper juridical entity, often in the form of an association (therefore, analogous to the recent network organization supported by Italian laws). This governance structure has the obligation of including mainly industrial, scientific, and academia personalities in its high-responsibility levels, but also being participated by representatives of the territorial populations involved in that local project. The driving association activity is based on a permanent group having a determinant role to facilitate the composition of projects consortia with different participants. The national government as well as local territorial municipalities would contribute in financing these structures. The main mission of the association which animates the competitiveness cluster can be summarized as follows: programming and applying the long-term industrial strategy of the cluster; selecting and coordinating the research projects to be the candidate for being supported by public funds, according to national and local political goals; promoting of the cluster, mainly at the international level; launching cooperation projects and programs with other clusters, both in France and outside.

In 2005, the national government assigned the periodic control of the political strategy on competitiveness clusters to an interministerial group (GTI) including members of some ministries and public entities, with responsibilities on territory planning, industry support, research, agriculture, health, transportations and so on. A first report of the main results of the political actions to support competitiveness clusters gave a clear evidence of the success of the initiative for 71 clusters, already constituted and operating that year (2005).

As described in the *Lettre d'Information* de la DGCIS (http://www.competitivite.gouv.fr), following the positive assessment of a first phase, the French government has recently decided to allocate €1.5 billion to the launch of a second phase (2009–2011). In addition to providing continued support for research and development—what is considered as the essential part of the clusters' activities—the funds are used in three specific areas: first, strengthening leadership and strategic steering for clusters through performance contracts; second, new means of financing to create innovative platforms; third, developing a growth and innovation ecosystem in each cluster (including private financing and better regional synergies). Each competitiveness cluster draws up a five-year plan, based on a vision shared by the various stakeholders. Under this plan, once approved, the cluster can:

- Develop partnerships between the various stakeholders, based on their complementary skills.
- Construct shared strategic projects that can benefit from public funding.
- Promote an overall environment which could foster innovation and the cluster's stakeholders via knowledge-sharing and mutual support among cluster members on topics such as training and human resources, intellectual property, private-sector financing, and international development.

In addition, a set of international actions are aimed at:

- Allowing clusters to take part in implementing a European policy for developing world-class European clusters.
- Encouraging cluster members to develop technological partnerships with international stakeholders.
- Contributing to make France attractive by encouraging international investors to initiate partnerships with the clusters.

The French Government is particularly interested in promoting an environment able to foster new enterprise creation and innovation, and to support research efforts within competitiveness clusters. It accompanies cluster development at both local and national levels in the following ways:

- By allocating financial support for the best research and development platform initiatives via calls for funding new projects.
- By involving various partners, such as the Caisse des Dépôts, or the French National Research Agency in order to finance research projects led by cluster stakeholders.
- By seeking assistance from local authorities, who can also provide financial support for cluster projects.

Some figures can give a better idea of the national support to the competitiveness poles' project. Recently, a set of 71 competitiveness clusters have been officially identified. They involve about 5,000 companies as cluster members (monitored in 2007), among which 80% are SMEs.

In terms of supports to clusters, more than 500 research and development projects have received public funding since 2005, for a global amount of funds greater than 1.1 billion Euro, including more than 700 million Euro from the Government (more than 50% to SMEs). The personnel employed totaled 12,000 researchers who take part in funded R&D projects.

The success of the French approach to the cluster promotion and support is evident from the above set of data. One of the main motivations of this success is the way by which the national government and the local municipalities attribute funds to selected projects and apply accurate controls of results. Looking at March 2009, 91 projects presented by 53 competitiveness clusters have been selected, for a global amount of financed budget of more than 100 million Euro, after a deep evaluation of all the proposals (as reported in public reports of the French Ministry of Economics, Industry, and Labour). Another motivation of this success is the clusters' opening to enterprises of different countries, starting from the common participation to research and development projects. This makes possible the inclusion of foreign enterprises in French clusters, as it recently occurred in the ICT and bioengineering sectors.

A picture giving a comprehensive outline of the competitive cluster diffusion in France is reported in Fig. 2.2. This figure (included in several web sites as well as in the mentioned Lettre d'Information de la DGCIS) could give an impressive view of a result: how a national policy stated to program balanced developments of

Fig. 2.2 Mapping of the 71 competitiveness clusters in France
Source DGCIS—January 2009, http://www.competitivite.gouv.fr

different regions and, to this aim, open to contributions from outside can generate so strong beneficial impacts on a national economy, even in a period of deep crisis.

2.4 The UK Cluster Experience: From Tradition to Innovation

The idea of local concentrations of specialized industrial activities yielding benefits in terms of higher productivity was hardly new, especially in UK. Already during 1890, British economist Alfred Marshall set out a description of geographical concentrations of specialized industrial activities. He stated that, once

enterprises' concentrations are established, they reinforce themselves by attracting complementary activities at various stages in the supply chain. In addition, they create a pool of specialized labour which can greatly support the spillover of know-how between firms.

Some vestiges of these specialized industrial areas remain visible in England. Examples are the cotton spinning areas of Yorkshire and Lancashire, the potteries in Staffordshire, cutlery and steel in Sheffield and metal manufacture in Birmingham and the Black Country. Presently, industrial systems in these areas have now only a shadow of their former so apparent industrial strength, thus demonstrating that even successful areas can decline if they fail to innovate themselves as required to counter competitors operating in the global economy.

The general situation of clusters in UK, however, is quite different from the mentioned areas, and a strong interest of the national government towards SME groupings, mainly in high-tech, has generated cluster development programs of evident impact.

Referring to the European Cluster Observatory and to the Europe INNOVA Cluster Mapping Project, financed by the European Commission (re: http://www.clusterobservatory.eu), there are four different definitions of clusters in UK.

1. According to the UK Department of Trade and Industry (DTI), clusters are concentrations of competing, collaborating and interdependent companies and institutions, which are connected by a system of market and non-market links.
2. The Invest Northern Ireland defines clusters as geographic agglomerations of firms in the same or closely related industries.
3. The Scottish Enterprise defines clusters as a group of industries and organizations linked by a common goal or practice.
4. The Welsh Assembly's Department of Enterprise, Innovation, and Networks defines cluster as industries linked through vertical (buyer/supplier) or horizontal (common customers, technology, channels) relationships.

Sources for further information on these differences could be the United Kingdom Department of Trade and Industry (http://www.dti.gov.uk), the Invest Northern Ireland (http://www.investni.com), the Scottish Enterprise (http://www.scottish-enterprise.com) and the Welsh Assembly Government's Department of Enterprise, Innovation, and Networks (http://new.wales.gov.uk).

The different definitions of clusters show a significant difference in promoting and supporting the cluster creation, and also in evaluating the real effectiveness of the cluster organization, in the various home nations of UK several agencies.

The DTI is the UK government branch responsible for the cluster policy. But some responsibilities of the DTI have been transferred to regional authorities. The DTI's cluster policy is to generate stable conditions that foster the development of clusters, but not to artificially create them. Under this condition, some main themes were identified as being essential to cluster development:

- The role of Higher Education Institutions that are responsible for knowledge transfer and evaluating funding programs for the exploitation of science.

- The growth of personnel skills: to this aim, the Government, employers, and industries can develop a demand-led education system to increase the regional level of personnel skills and innovation in clusters.
- The access to finance with the support of a new Small Business Service, which was created to help small companies access finance more easily.

Besides DTI, Regional Development Agencies (RDA) were created in 1998, to promote decentralization such that the work of the DTI could be performed on a regional basis. The RDAs became responsible for planning and reviewing the economic development strategies, and for monitoring and accompanying the strategies to achieve fruitful outcomes. In this context, they had the task of designing collaborative projects to engage the various actors in clusters to encourage innovation activity and knowledge transfer between the companies, universities, industry experts, training organizations, business associations, and venture capitalists.

On the other hand, the Secretary of State was responsible to provide guidance on any issues in the strategy formulation, adoption, and revision, on determining the financial duties of the RDAs (Fig. 2.3).

The devolution process, initiated in the 1990s, has given increased competencies, but in different ways, to the Northern Ireland, Scottish, and Welsh 'home nations'. These home nations have developed proper agencies which report to their respective Assemblies, not the UK Department of Trade and Industry. On the contrary, the RDAs still refer to the DTI: this is evidence of a lack of cooperation which could reflect on inefficient relations and also conflicts.

In general, the development agencies of home nations support business growth and investment, promote innovation, research and development and in-company training, encourage exports and support local economic development and company start. Besides the business support service, some agencies do not appear to have an

Fig. 2.3 Some UK regions with proper Regional Development Agencies

explicit cluster policy. Other agencies, in turn, promote programs for cluster development: as examples, the 'Innovation Society Initiative', the UK Business Clusters Assessment, and the 'Scottish Tourism' initiative (for more details, refer to the websites of Department of Trade and Industry, Business Clusters in the UK, and of Scottish Assembly Government, respectively).

The three mentioned examples of public support programs are quite different from each other, and show the complicated and often not so clear way of approaching the SME clustering problem. The UK Business Clusters Assessment has been a program financed by the UK Office of Science and Technology, with the scope of describing a map of the different clusters in UK, and classifying them into four categories: embryonic, emerging, mature, and declining. The effective result of this initiative has been the dissemination of information, but a real impact on the clustering evolution is questionable. The Innovation Society Initiative has been financed by the Department of Trade and Industry of the UK government, over the period 1996–2000, with the scope of supporting SMEs in all sectors of the UK economy such as to improve their competitiveness by using new ICT tools. The Scottish Tourism initiative, in turn, defined over the horizon 2006–2016, has the scope of creating a new tourism research network involving industry, culture and heritage organizations. A special organization has been created to support the initiative, and a number of concrete projects have already been defined.

Above the level of agencies and programs, the policy level needs to be understood if a clear vision of the UK perspectives for the SME clustering is desired. Generally, it can be seen that cluster policy is considered an important issue both at the national and at the regional level. Research conducted by the UK Department of Trade and Industry have shown that clusters, mainly if composed by SMEs, have an important impact on the economic development of territories. This diffused opinion is the cause of the initiatives as the ones mentioned. However, laws or regulations to define and apply cluster promoting policies are lacking. The same RDAs can be viewed as 'facilitators', and they can support initiatives but only at the regional level, thus showing different strength's and different's interest towards SMEs and their potential aggregations.

2.5 Clusters in Germany: The Initiative Competence Networks

A comprehensive view of the industrial clusters situation in Germany in recent years can be found from the work done in the frame of the Initiative Competence Networks Germany (refer to the web site: http://www.kompetenznetze.de), launched by the Federal Ministry for Economy and Technology—BMWi, and involving about 100 of the most innovative German competence networks. In addition to the federal level, also involving the Ministry for Research and Education—BMBF, cluster supporting initiatives are launched also at the regional level. As a consequence, Germany presents a double type of cluster funding, which can promote, in different ways, three types of clusters:

- Clusters created by government initiatives—usually at the regional level—to be considered as 'top-down externally initiated networks', whose managers are generally nominated by the promoter and whose evolution is strongly dependent on public funding;
- Clusters originated by a local initiative or by a lead organization, but also strongly supported by local governments, to be considered as 'top-down internally initiated networks', again largely influenced by local political environments and dependent on public funding;
- Clusters created outside any public initiative and independent on federal policy makers, named 'bottom-up networks', whose coordinator is usually selected by members, and which can operate with low political influence.

In practice, there can be found a mixture of these three scenarios, even if the first two are more frequent. A recent analysis of the Institute for Innovation and Technology—IIT (refer to: http://www.iit-berlin.de) presented a distribution of the three types of clusters showing the dominance of the first type (about 70%), with a low percentage of the latter (about 8%). For what concerns the sources of funding installments to clusters, the same research shows a prevailing importance of the public contributions over private: the latter can reach the percentage of about 15% over the global funding amount. Intuitively, the share of either public or private financing strongly depends on the type of cluster (among the three above mentioned): for bottom-up networks, the private funding can be greater than 60%; much lower in case of top-down networks.

The German clusters, their creation, and their main characters have also been investigated by the already mentioned Europe INNOVA Cluster Mapping Project supported by the European Commission, giving further insights in the German cluster policy of the German federal and regional governments.

During the last years, the attention of public administrations to clusters was greatly increasing. Since 1995, BMBF Ministry launched a new approach to clusters funding, named BioRegio Competition: the scope was to force local industrial communities operating in biotechnologies to activate closer and closer interactions such as to be able to develop commercial applications in a shorter time. This competition, indeed, has a significant impact on the industrial communities: today, this sector is showing an increasing importance, clearly viewed also at the European level.

During 2005, the federal government planned to foster the creation of new networks and clusters, mainly based on innovative enterprises, declaring a desire for an efficient scientific and research system that is internationally competitive. To ensure this, university and non-university research should be better networked and the transfer of technology managed through a modern policy of cluster development. To this aim, in 2006, the federal government has started to develop for the first time, a comprehensive High-Tech Strategy involving all its ministries.

At the level of the Länder, programs fostering network structures between science and industry have been implemented since the 1980s. That means, that the Länder—in particular Baden-Württemberg, Bavaria and North Rhine-Westphalia—supported

cluster policies before the federal government started its first cluster program. Only recently, the Länder started to use the term 'cluster policy'.

The policy of the German federal government devoted to strengthen clusters can be summarized in the following main points:

- Promote exchange processes between universities and companies: the aim is to identify particularly successful exchange processes between science and industry, present them to the public and foster the progressive development of the concept behind such relationships.
- Promote non-technology-specific collaboration: the scope of this second type of initiatives is to support cluster projects, able to integrate the entire innovation process—starting with basic research and extending to the translation of research findings into new products—are also to receive assistance. In such projects, the basic research is financed by, for example, the German Research Foundation, while the application-oriented research by the government through a Collaborative Industrial Research program.
- Regional measures to support the development of clusters: this involves a set of instruments defined for developing efficient, high-powered locations for innovation mainly in the Germany's New Länder.
- Measures to support clusters in individual fields of technology such as white biotechnology and regenerative medicine.

The instruments promoting the economic development of the New Länder is going to be organized in an even more targeted manner in order to promote the industrial and innovative concentrations and clusters that have been created in recent years. It is the scope of the SME policy of the federal government to convert the high innovation potential of SMEs into innovation activities by strengthening their investment capability. This goal is considered by the German government particularly important because the SME sector provides approximately 70% of all jobs and 80% of all training positions in Germany. Therefore, it is particularly important to revive investment activities in this sector. Today, SMEs have to spend about 4–6% of their turnover on administration costs caused by the State. Therefore, less bureaucracy creates new opportunities for creative enterprises with innovative ideas. SMEs in particular will benefit from the improved tax deductibility of labour costs for maintenance and modernization measures in private households.

Despite these initiatives, some experts, interviewed by the mentioned Europe INNOVA Cluster Mapping Project, recently expressed the conclusion that clusters do not play a significant role as a framework in the German entrepreneurship and SME policy. They expressed an opinion quite diffused in Germany, where the cluster policy is a matter of considerable debate. Some people think that a policy approach which, in practice, is 'strengthening the strong bodies' could increase the regional disparities, even if it could often support the weakest regions. Intuitively, this debate emphasizes the two opposite opinions widely diffused in Europe, today. No clear evidence could now solve the problem. The unique sure consideration

Fig. 2.4 Map of 'Kompetenznetze' networks in Germany

could be the following: clusters, indeed, offer real opportunities to SMEs. Is this sufficient to run the risk of 'strengthening the strong'? (Fig. 2.4).

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Chapter 3
Collaboration Analysis for SME Networks

D. Antonelli, X. Boucher and P. Burlat

Abstract This chapter presents two complementary points of view on collaboration analysis, applied to SME networks. The overall objective is to help managers in detecting interesting collaboration opportunities. The analysis is made further more complex because the source of data is by necessity, indirect (it is not possible to ask the enterprises if they actually cooperate or only fake cooperation). Despite the difficulty, many techniques were found to indirectly assess the presence and the amount of collaboration in a network. A first analysis, at a strategic level (based on criteria of competence similarities and activity complementarity) it is complemented by a more operative point of view (analysis of production links among potential partners).

3.1 Discussion on Collaboration Analysis

Inter-enterprise collaboration is widely acknowledged to have a positive effect on firm efficiency, quality, and profitability. For common understanding of collaboration,

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we can refer to the simple and clear definition provided by Strzelec 'Collaboration is multiple enterprises working in concert to execute critical business processes while sharing responsibility, quality, and accountability'. Inter-enterprise collaboration can be deployed in a large variety of contexts. In the context of collaborative supply chain, the client companies can spread information about their production programs with the whole chain and not just to their direct suppliers, allowing a better logistic organization of the whole SC. Several other collaboration contexts have emerged along the years, like Virtual Enterprises, Business Ecosystems, Industry Clusters or Collaborative Networks. Collaborative Networks (CN) are characterized by a widespread information sharing among the networked companies, that goes far beyond the supplier–client relationships. As a matter of fact, collaboration can be applied to most enterprise key processes: design, marketing, distribution, personnel training.

As a consequence, there is a high diversity of successful collaboration examples: the widespread practice of developing new parts by co-design between the client and the supplier; the marketing practice of advertising a brand common to all the firms in a regional cluster, sometimes by obtaining that the product be manufactured exclusively in that region (Appellation d'Origine Contrôlée in France, Denominazione d'Origine Controllata in Italy); the creation of scientific or technologic parks composed by a number of enterprises located in a territory having strong links with a local University or Research Center, etc. This diversity of collaboration schemes, answers the needs to adapt to a constantly changing economic context. These new organizational forms have been supported, in the recent years, by large research and business practice communities which have made possible the development of a new theoretical background and the foundation of a real scientific discipline on 'Collaborative Networks' (Camarinha-Matos et al. 2007).

Among the numerous topics of this scientific advances, performance management appears as a key issue which can be addressed from different points of view. A first part of the scientific contributions focus on developing and formalizing indicator systems specifically adapted to inter-enterprise collaboration contexts. This first point of view on performance is mainly based on a vision of performance 'a posteriori'. The execution of collaborative processes can be supervised a posteriori thanks to indicator system which has been previously specified to help improve collaborative weaknesses. The definition of performance management systems (PMS) for collaborative networks can be developed as a customization of more classical performance models (Gunasekaran 2001). For instance, the Balanced Score Card approach (Kaplan and Norton 1992) can be used as a general framework to structure the numerous complementary aspects covered by collaborative network KPIs (Graser et al. 2005). Another example is provided by the use of the SCOR model for performance management of Collaborative Supply Chains. SCOR is a Supply Chain Reference Model used to assess the performances either in terms of operating the production and logistics of the Supply Chain (SC), or in terms of managing the SC (organization and strategic vision). SCOR defines as much as 200 key

performance indicators (KPI) to completely describe the different functions included in a SC. An alternative reference model is provided by generalized enterprise reference architecture and methodology (GERAM) framework, as a generalization of several enterprise architecture methodologies (Bernus et al. 1997). GERAM had a strong impact on enterprise integration projects worldwide, for example the Globemen consortium developed a specialization of this framework for Virtual Enterprises (Zwegers 2003). All the alternative approaches propose sound and coherent indicator systems structured in different point of views: financial, productive, logistics, organizational.

However, the applicability of these approaches remain questionable, notably because of a high (perhaps excessive) number of KPIs generally proposed: all the stakeholders of a collaborative network have to be considered and, furthermore, collaboration management indicators are defined in addition to more local enterprise indicators. To contribute to alternative solutions, this paper adopts another point of view on performance management. This approach follows an 'a priori' point of view on performance: the question is not to provide an a posteriori supervision of performances, but to evaluate the collaboration potential among large sets of partners, in an early collaboration building phase which involves detecting enterprise clusters which could lead to efficient collaborative networks. This approach is notably based on analyzing collaboration links among potential network partners.

The existence of collaboration links among industries is not sufficient by itself to describe collaboration. In order to assess the importance and the effectiveness of collaborative mechanisms, it is also important to consider that industry networks can implement different degrees of collaboration. Referring to Childerhouse et al. (2003) it is possible to classify the following collaboration levels:

- Ad hoc—collaboration does not go beyond the traditional customer supplier relationship.
- Defined and linked—collaboration focuses on operational issues, limited to collaborative planning, forecasting, and replenishment of materials and capacities, i.e., SC management.
- Integrated and extended—collaboration is positioned at a strategic level where integrated and coordinated strategies lead to strategic synergy, i.e., extended and virtual enterprises.
- To this spectrum of maturity, we would also add clusters, which represent integrated collaborations that also include 'supporting infrastructures'.

Thus, 'collaboration' is a term which covers a wide spectrum of notions and conditions when applied to the industrial world. Collaboration usually emerges from a series of informal and unplanned relationships among enterprises, made easier because of geographic proximity (Hakansson 1990). Some authors have put forth that 'many aspects of business relationships can never be formalized or based on legal criteria' (Gadde et al. 2003). Extending to cluster, the value analysis methodology, some studies (Bititci 2004) attempted to make use of the value creation in collaborative networks. Their research identified different levels of

collaboration and categorized each one accordingly, analyzing, and identifying the value transactions in case of each collaborative enterprise model. The conclusion is that, it is not possible to define a single criterion to describe the outcome of collaboration.

Additionally, the extension to CN of analysis methods developed for a single enterprise or even a SC, is confronted by the difficulties in collecting reliable data through interview campaigns, both because of the difficulty to get access to the right persons for all information required and because of the partiality in the information transmitted, which are re-enforced by the distinct rationalities of the collaboration stakeholders. To try and go beyond such limits, the current chapter proposes an approach to assess collaboration opportunities within industry networks, using unbiased data either based on the existence of information flows among enterprises or on web-based public information.

The assessment of collaboration opportunities among firms is proposed in the following sections at two complementary levels: the strategic and operational levels of collaboration. From a strategic point of view, the cooperative opportunities are assessed by focusing on two specific factors: competences and activities within the firms. By a formal model of competence similarities and activity complementarities among companies, the approach generate a map of potential coordination modes within a network. In the following section, we also illustrate an information extraction procedure to automate this decision support system. From an operational point of view, concrete information on production flows among companies is analyzed, making it possible to generate another point of view on potential company clusters.

3.2 Collaboration From a Strategic Viewpoint

3.2.1 Cooperation and Networked Enterprises

In economics, cooperation has been defined by Richardson (1972) as a hybrid organizational form between hierarchy (where coordination is planned) and market (where coordination is spontaneous through price mechanisms). In this case, firms tie links beyond their traditional boundaries, so as to coordinate their activities with other companies. This will happen for example, when firms have technical agreements, sub-contractual relations, marketing associations, and so forth. Recently, many terms have appeared to designate such organizations more accurately: ‘inter-enterprise networking’ (Brown et al. 1995), ‘extended enterprise’ (Jagdev and Brown 1998), ‘agile virtual enterprise’ (e.g. Goranson 1999), and so on. Within these architectures, firms are extending their usual perimeter of decision by establishing cooperation links with partners.

Many works have categorized cooperative networks, thanks to the direction in which the decision area is extended. For instance, Thoben and Jagdev (2001) have proposed a classification to describe networks according to the direction of the

cooperation across the value chain: vertical, horizontal, or diagonal. A vertical cooperation integrates non-competing companies of the same product/market sector, processing successive steps along the production flow (SC are typical examples of vertical cooperation). A cooperation is classified as horizontal when it groups competitors acting within two different value chains and pooling resources to reduce costs. A diagonal cooperation ties companies from different sectors that are neither competitors nor successive actors of the same value chain, but have common interests such as basic research. Such a value-chain oriented typology gives us a first key to understand the incentives leading companies to cooperate. It will now be completed with an analysis of the known factors influencing networks formation.

3.2.1.1 Factors Affecting Network Formation

Many factors[1] affecting network formation have been identified from various fields of research such as economics, industrial engineering, management, and social sciences. More precisely, practical studies about SMEs networking have detected attributes having either accelerating or braking effects on cooperation. These factors are regrouped beneath in two categories: internal parameters and proximities with other firms. We shall describe them by focusing on SMEs.

Internal Parameters

They represent the interior characteristics that influence the capacity of a firm to develop strong cooperation links with its partners. Here, we are referring to family culture, size of enterprise, degree of internationalization, and degree of diversification. Kets de Vries (1996) who has studied family companies, points out specific characteristics that differentiate them from other types of firms: when the managers are members of the owner family, keeping the control of the enterprise and preserving the strategic autonomy is a priority. Thus, the family culture in a firm may brake the development of cooperation. It also plays an important part in fusion/acquisition decisions. Hagedoorn and Schakenraad (1994) have observed that SMEs often accept organizational changes in the structures and routines with difficulty. More precisely Menguzzato-Boulard (2003) have shown that, the smaller the firms are, the more disturbing the cooperation would be. Agarwal and Ramaswami (1992) have studied why internationalized firms deal more easily with cooperation than national firms. In fact, the international enterprises are confronted more often by cooperation issues, because access to the global market usually

[1] These factors are either relating to the market contingency or to the firms' characteristics. As an example of market contingency, have shown that incentives to collaborate for R&D projects are intimately related to the nature of market competition and the costs of forming links. However, we will concentrate here on firms' characteristics, for we are interested with manufacturing organizations.

requires relations with local enterprises, to overcome the legal and cultural barriers. Chang and Singh (1999) have analyzed the impact of diversification: the enterprises possessing a large set of competences and activities, are more capable of discovering new opportunities while combining some of their capacities with others that are complementary. Therefore they will cooperate more easily.

Proximities

In addition to internal parameters, the degree of closeness between enterprises also affects cooperation. It is usually referred to as 'proximity' between firms. Three essential types of proximity are commonly identified: geographical, organizational, and institutional proximity. Geographical proximity does not only depend on a physical distance between firms, but also on other factors such as transport infrastructures and transportation costs. In some cases, especially for SMEs, geographical proximity will facilitate interactions, whereas geographical remoteness can create barriers to developing links. For instance in the production field has studied how the constraints of localization impact the building of, just in time delivery networks. In terms of organizational proximity, firms are nearby when they relate to close working modes, share similar knowledge and representations, and accept common frameworks to structure their trades. This facilitates exchange of information and knowledge, and encourages collaboration. Last, institutional proximity refers to the acceptation of common laws, mental models, values, and ways of thinking. This proximity result from an adhesion to social conventions and behavior norms,[2] and facilitates the creation of links. For example Burlat and Peillon (2002) have exposed case studies showing the role of organizational and institutional proximities within SMEs cooperation.

It is true to say that the natural development of networks is often guided by geographical proximity and pre-existing connections within industrial districts (ID), and that already formed personal ties between managers have a significant influence on the formation of industrial architectures in the SMEs world. Consequently, many research works on the SMEs networks have focused on detecting factors having positive or negative effects on actual existing links. However, most of these factors are detectable within firms, but scarcely modifiable. Consequently they cannot be used to control cooperation within a network. For example, this is the case concerning the family culture, or the size of enterprise. To overcome this drawback, several research projects, set out to provide shared software tools to strengthen the organizational proximity within a network, so as to improve its actual ties. Other projects are; offering best practices such as checked roadmaps and tested organization for management, in order to improve the efficiency of

[2] It differs from the organizational proximity in the way it does not require organized and coordinated actions. A mental adhesion to institutional values is enough to ensure institutional proximity.

network formation. Nevertheless, we still need formal and quantitative tools to indicate whether a firm is capable of designing and maintaining new cooperation links with partners, independently of pre-existing personal relations. So, besides this related work, our contribution proposes a methodology to evaluate both the pertinence of existing connections and the potentialities of new ones within a group of firms. Our analysis will be based on the use of complementary activity and similar competency scores to evaluate an industry structure. Indeed, these two parameters have not been used so far for quantitative instrumental research on SME networks. However, they are relevant in the detection and control of efficient potential cooperation, as we will now see.

3.2.1.2 Identifying Potential Cooperation Modes Through Activities and Competences

Complementary Activities Require Cooperation

When Richardson (1972) identified the hybrid coordination form between market and hierarchy, he wondered what kinds of coordination should be assumed by conscious decisions within firms, what can be left to the working of the 'invisible hand', and what should be concluded through inter-firm cooperation. He answered in terms of complementary activities and similar competences. In economics, two activities are said to be complementary if the increase of one of these activities increases the marginal profitability of the other (Milgrom and Roberts 1997). As we focus on the production field, activities will be regarded here as complementary if they correspond to various successive phases of a production process, or if they constitute highly interconnected steps of an administrative process bound with manufacturing goals (for example: stage of Marketing and stage of Research and Development within an innovation process). Industrial economics theory states that complementary activities must be generally coordinated in advance. For instance within a mechanical process, it is essential to plan in advance the quantities of components, and to synchronize the dates of arrival of subsets for assembly. It is also necessary to coordinate the specifications of every subset (in terms of dimension, features, etc.), to enable the assembly process. So, most of the time complementary activities cannot be coordinated through a simple spot market mechanism of price and exchange: they require stronger coordinations, either through close inter-firm links[3] or even through firm integration. So at this point, we assume that complementarity of activities seem to be a prior factor explaining network formation. Now, in order to specify more precisely what should be coordinated through network links or by a hierarchical management structure within a firm, we have to consider the required competences to carry out activities.

[3] In the car industry for instance, this coordination is assumed by inter-enterprise cooperation thanks to extended logistic chains.

Similarity of Competences may Lead to Integration

A competence, here, is 'an ability to sustain the coordinated deployment of assets in a way that helps a firm to achieve its goal', and assets are 'anything tangible or intangible the firm can use in its processes for creating, producing, and/or offering its products to a market' (Sanchez et al. 1996). In modern manufacturing, a single business does not often possess a complete set of skills to offer competitive solutions, and to be efficient, firms tend to center on activities that require the same abilities: they focus on core competences and outsource other activities. Indeed, concentrating heterogeneous professional skills within one firm is costly in terms of management. In fact, producing, using, coordinating, and maintaining know how engender internal transaction costs (Williamson 1885). Therefore, according to Transaction Cost Economics, activities needing non-similar competences should rather be coordinated through market forces, or inter-company cooperation. On the other hand, activities requiring similar competences may have advantages in being coordinated in hierarchical direction within a single company, especially to gain economy of scopes and to promote learning curve effects.

Crossing Activities and Competences Analysis

Now, the previous competences and activities analysis are combined to suggest potential coordination modes between firms:

- First, when activities are complementary and require similar skills, regrouping under the same hierarchical direction within a single firm appears as an efficient coordination mode.
- Second, when activities are complementary and competences are not similar, a frequent and efficient coordination mode is inter-company cooperation. Such SMEs networks, with complementary activities and non-similar competences have been analyzed in the production field (e.g. Burlat et al. 2003). They correspond to networks where enterprises cooperate together at successive steps of the production flow, each one remaining on its proper core of skills. They cooperate to design together the products they manufacture, and to schedule accurately their workshops via exchange of information. Finally, their grouping enables to add value to the final products, thanks to higher creativity in the design phase and to better respect of deliveries to final customers. We call them 'proactive networks (PN)', because we have noticed that innovation is a keystone for these networks, and that they often tend to anticipate the needs of the market.
- A third type of situation may arise when competences are similar and activities are not complementary. In the manufacturing field, it means that the two firms are not in the same production flow. Here, inter-company cooperation may also be relevant. A single condition is that, the two firms are not close competitors on the same market. We have already observed such a situation, where enterprises

Table 3.1 Networks analyses according to activities and competences

	Non-complementary activities	Complementary activities
Non-similar competences	Market	Proactive network
Similar competences	Reactive network	Firm

with similar competencies cooperate to reduce costs. We call it 'reactive network'[4] because we have observed, it often corresponds to a defensive reaction, to environment constraints such as costs cutting. In that case, SMEs are forced to work together in order to exploit the economy of scales, for example by sharing resources. Finally, Table 3.1 summarizes this analysis.

3.2.1.3 Discussion

Of course, such a typology is a delimited view of networking, and as such it should be balanced by the input of the many other factors that influence network relationships. Indeed, only two internal factors (competences and activities) are used here to explain company decision-making in cooperative projects. In real world many other factors, both internal and external are relevant. For example, a merger may be detected as theoretically efficient from an economics point of view, but unrealizable in the field. Indeed, our analysis does not take into account prevailing constraints like the fact that the company assets may not be perfectly tradable or not always available. So Table 3.1 should not be considered as a determinist framework to build links, but as a way to detect potential relationships. However, it will provide a base for a fairly objective approach to identifying potential networking links between enterprises. So in what follows, we offer a method to model our two selected parameters: activity and competence.

3.2.2 Application: Automated Extracting Information Procedure

As an implementation of the conceptual approach presented above, the Ph.D. thesis of Hajlaoui (2009) contributed to automate the extraction of the information necessary to apply the clustering approach proposed. The objective of this work is to use the public information available on company websites, in order to assess activity complementarity and competence similarity. Two distinct information mechanisms have been formalized and implemented (Fig. 3.1): the first one oriented on identifying enterprise activity field (developed in Sect. 3.2.2.1), and the second one oriented on characterizing company competencies (developed in

[4] Note that 'Proactive' and 'Defensive' are essentially terminologies to identify the nature of the links.

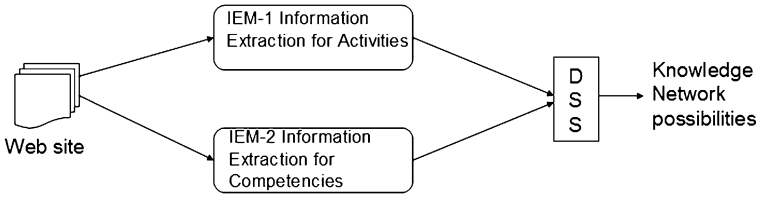

Fig. 3.1 Two complementary information extraction mechanisms

Table 3.2 Case study with 10 SMES

Entreprise (SME)	Website
Boisset et compagnie S.A.	http://www.boisset-et-cie.fr
Chambon S.A.	http://www.chambon.com
Flip Elec	http://www.flip-elec.fr
J. Martin Décolletage	http://www.martin-joseph.com
Bargy-Décolletage S.A.S	http://www.bargy-decolletage.com
EM technologies	http://www.entechno.fr
Attax assembly systems	http://www.attax.com
Mecasonic	http://www.fti-mecasonic.com
IsoJets equipements	http://www.isojet.com
Sic-marking	http://www.sic-marking.com

Sect. 3.2.2.2). These semi-automated information extractions make it possible to apply clustering procedures, afterwards; so as to study activity complementarity, competence similarity and the resulting cooperation modes (Sect. 3.2.2.3).

In the coming sections, this decision assisted procedure is illustrated by a real case study of SMEs network building. The region of Saint Etienne in France is characterized by a large potential for SMEs in the sector of mechanical industry. To build the automated system of information extraction (i.e., IEM-1 and IEM-2), we used a sample of around 100 company websites. However, for sake of clarity, the case study will only consider a set of ten SMEs within this business area of mechanical industry (Table 3.2). The initial data on these companies are provided by their websites. The information extracted from the websites is used to identify the specific activity field of each company (Sect. 3.2.2.1), then to characterize its key competencies (Sect. 3.2.2.2).

3.2.2.1 Identification of Company Activity Fields

Identification of Activity Field

This section focuses on IEM-1: the information extraction procedure aiming at characterizing company activity fields, by using their web-sites as the only source of information. To make possible the information extraction, we used an additional

semantic resource, constituted by general data on mechanical industry. This external semantic resource is the national standard activity Code called NAF Code (NAF stands for 'Nomenclature des Activités Françaises'). The NAF Code Standard provides us with a conceptual hierarchical description of all activity fields within the business area of the mechanical industry: this hierarchical structure describes the activity fields as an arborescence of classes and sub-classes, where each distinct activity field is designated by one NAF code. In fact, the NAF Code Standard has been formalized so as to constitute a Hierarchical Controlled Vocabulary (VCH), i.e., a specific structured set of terms, later used for a procedure of 'controlled indexation'. Using this VCH, IEM-1 has been developed by adaptation and improvement of rather common information extraction methods. The procedure is composed of four usual steps: extraction, lemmatisation, indexation, and semantic similarity measure.

Figure 3.2 briefly synthesizes the four steps of this information extraction procedure. The initial information source is a company website. The output is the identification of one or several NAF codes which characterize a company. The procedure is based on a matching among several distinct information vectors (using similarity measures). The NAF Code Standard generates various 'document vectors', each corresponding to a distinct activity field (thus NAF code). These 'document vectors' are compared with a 'Request vector' characterizing each of the company. The objective is to identify the more probable NAF codes for every

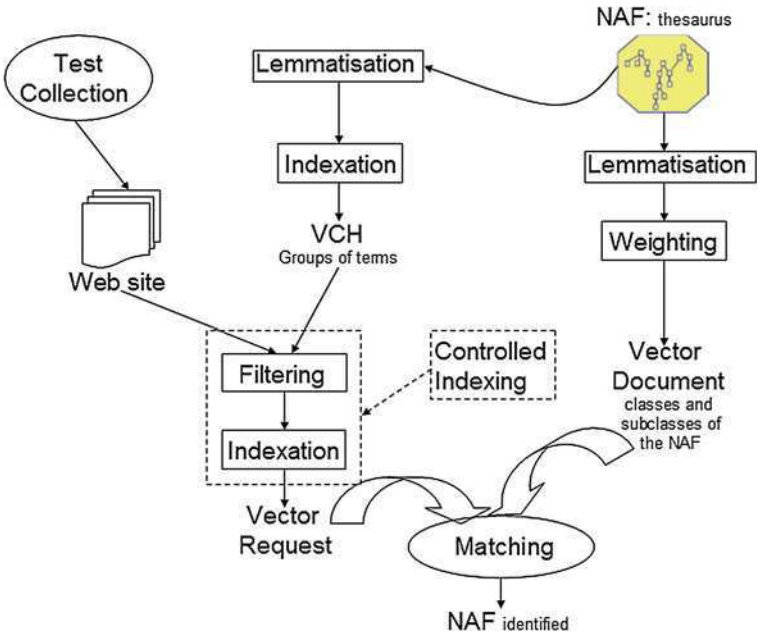

Fig. 3.2 Information extraction procedure for activity identification

company. With the objective to optimize the final performance of the overall information extraction procedure, several similarity measures have been tested and compared (Hajlaoui and Boucher 2009).

As mentioned above, a corpus of ten company websites from the mechanical industry was used to test the performances of the matching step, using classical indicators in the field of information extraction: recall and precision. The final performances obtained, demonstrated a good performance of the system. When applying the best similarity measure (a connexionist model), the extraction system identifies the right company NAF codes for 88% of the cases, with a recall of 95% and a precision of 55%. In the field of information extraction systems such performances are clearly good.

This identification of their activity field, the ten companies of the test collection were distributed on eight distinct NAF codes (some of the ten companies had similar NAF codes).

Analysis of Activity Complementarity: Results on the Case Study

The next step of the method consists in analyzing complementary activity, as mentioned in Sect. 3.2.1. To model if the activities are complementary, graph theory is exploited to facilitate the mathematic treatment required. A graph is used to represent a set of companies and their complementarities. Each node in the graph corresponds to one company, and the arc between two nodes represents an evaluation of the degree of complementarity. Here we have referred to a definition of complementarity which considers that two sectors of activity are complementary when they can both be used to achieve integrated products/services available on the market. Here again, the NAF Code Standard is used to assess generic degrees of complementarity among activity fields in the mechanical industry. When applying this generic information to the case studies of the ten companies, the graph of activity complementarity in Fig. 3.3 has been generated (as mentioned earlier the ten companies are distributed on eight distinct NAF codes).

This graph is used to apply a mathematical clustering algorithm. The intent of this partition algorithm is to isolate strongly inter-connected sub-graphs based on information loss minimization (loss of arcs, loss of potential complementarity). These sub-graphs will represent a set of very complementary companies from the point of view of activity analysis: this information on activity fields clusters will have to be completed with competence similarity analysis, before justifying potential collaborations. The clustering algorithm has been described in Burlat and Benali (2007).

For the case study of the ten companies considered, this procedure results in only two clusters of complementary companies:

$$\begin{aligned} &\text{Cluster1} = \{\text{E9},\ \text{E8},\ \text{E10}\};\\ &\text{Cluster2} = \{\text{E1},\ \text{E2},\ \text{E3},\ \text{E4},\ \text{E5},\ \text{E6},\ \text{E7}\}. \end{aligned}$$

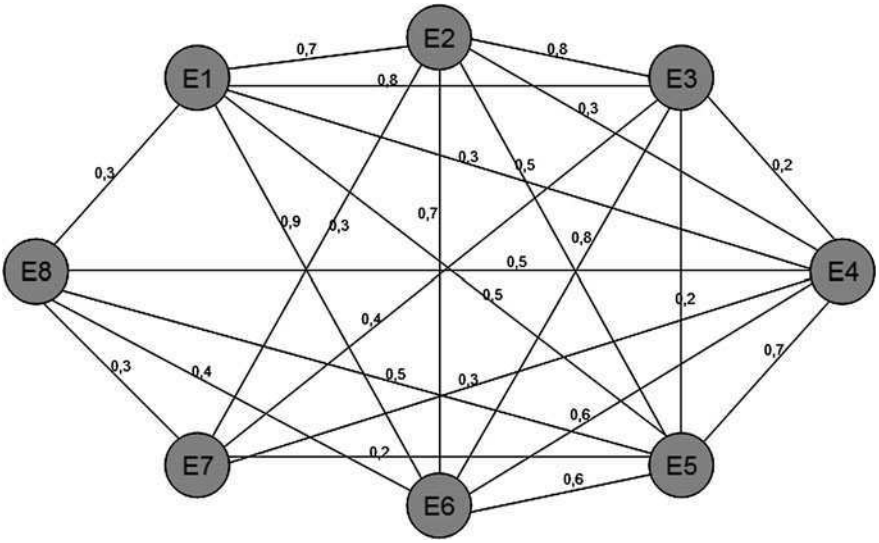

Fig. 3.3 The case study of company graph

3.2.2.2 Identification of Enterprise Competencies

Identification of Key Competencies

In this section, we describe the extraction procedure IEM-2 (see Fig. 3.1) focusing on identifying key competencies of the company. Due to the complexity of the notion of competence, the identification of competencies through website information requires implementing semantic mechanisms (Hajalaoui et al. 2010). The approach presented here uses ontology and linguistic patterns applied to the specific area of mechanical industry. The ontology has been built to provide a generic description of the potential enterprise competencies in the domain of the mechanical industry. Thus, the ontology provides a generic description of this domain and the projection of linguistic patterns on the corpus, is used to activate the ontology classes for each company, thus providing a 'company competence trace' (Fig. 3.4).

In fact the identification of competencies for each company is obtained by the activation of competence classes within the ontology of the domain. In our case, the linguistic patterns make it possible to formalize generic and re-usable expressions built on several relationship among lexical terms of the specific domain 'mechanical industry'. These patterns are used to identify without ambiguity the presence of ontological competence concepts (then competence classes) within the corpus extracted from a company website.

Both the ontology and the pattern bases have been implemented in a computer based tool called UNICOMP, which aims at extracting company competence

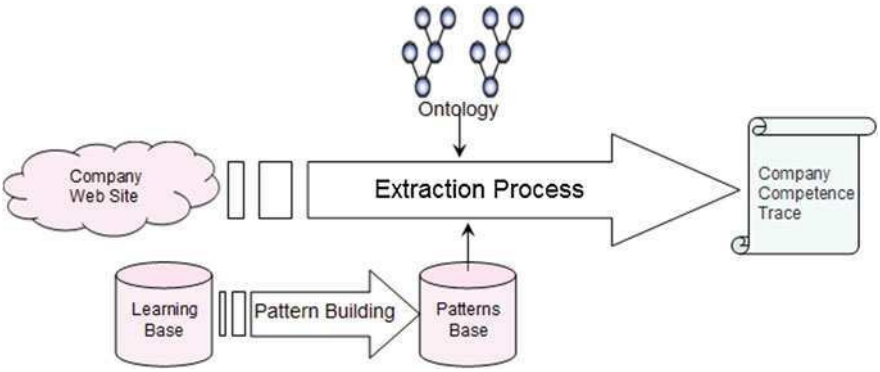

Fig. 3.4 Extraction process using ontology and patterns

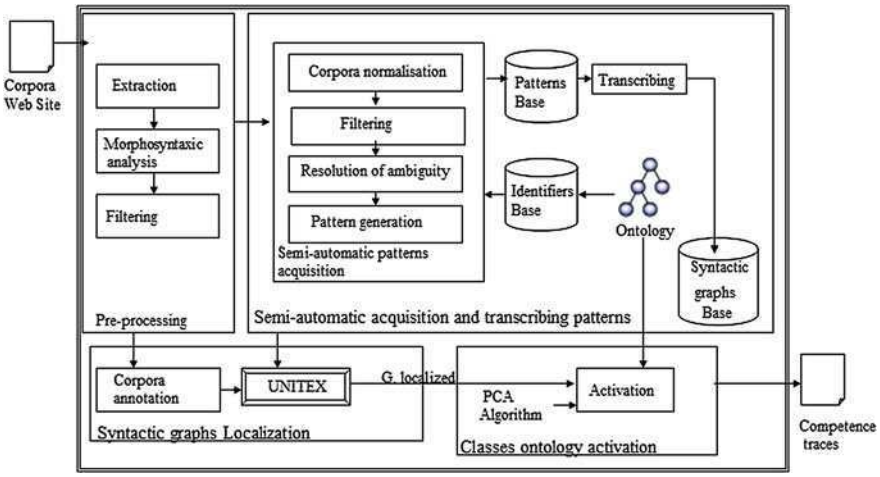

Fig. 3.5 Architecture of UNICOMP system (Hajlaoui 2009)

traces, using public information available on websites. It is constituted of four modules (Fig. 3.5): *Pre-Processing, Acquisition and transcription of patterns, Pattern localization* and finally, *Class activation*. UNICOMP System has been more largely described in Hajalaoui et al. (2010).

The performance of competence identification using UNICOMP has been tested using the same corpus, than for activity identification (Companies in mechanical industry). The performance evaluation of UNICOMP system is based on a comparison performance between this automated system and a human expert, concerning the ability to identify competence classes from the information available on company websites. The human expert provides a reference of expected result,

Table 3.3 Comparison between performances of UNICOMP and a human expert

	Precision (mean for ten websites)	Recall (mean for ten websites)
Competence class identification by UNICOMP system	0.84	0.75
Competence class identification by a human expert	0.87	0.64

and this reference makes possible to define the two indicators *precision* and *recall* already used in the previous section. The results for the ten companies of the Case Study (Table 3.3) underline that the automatic competence identification using UNICOMP gets performances very close to the human expert's performances. The automatic system even gets a higher precision: this can be explained by the fact that the identification of competence class among the more than 50 potential ontological classes is a tricky task for the expert.

As a result of this step of competence identification, each of the ten companies of the case study has been characterized by a set of enterprise competencies, resulting from the activation of generic competencies in the ontology. This first result is then used to proceed with competence similarity analysis.

Analysis of Competence Similarities: Results of the Case Study

The key competencies identified for each of the ten SMEs are described by a sub-part of the competence Ontology. Thus, the competence similarity among companies can be assessed by a comparison among distinct sub-parts of a generic ontology. A mathematical distance among hierarchical threes has been used to evaluate this similarity: the Hamming distance defined by formula 3.1 has been chosen.

$$\delta(o,o') = 1 - \frac{\sum_{P=1}^{P=4} P\left|L_p(o) \cap L_p(o')\right|}{\sum_{P=1}^{P=4} P\left|L_p(o) \cup L_p(o')\right|} \quad \begin{array}{l} \forall o, o' \in O, \delta(o,o') \geq 0\,(positivit) \\ \forall o \in O, \delta(o,o) = 0\,(minimalit) \\ \forall o, o' \in O, \delta(o,o') = \delta(o,o')\,(symtrie) \end{array}$$

Formula 3.1 Similarity measures and its mathematical properties.

The application of this similarity measures to the ten SMEs of the Case Study provides the following similarity assessment (Table 3.4)

This similarity matrix is then used to classify the companies according to the intensity of their degree of similarity (high, medium, or low). If we consider a high degree of similarity among firms, the following pairs of similar companies are identified:

{E1, E3}{E2, E8}{E3, E10}{E5, E10}{E7, E8}{E7, E10}{E8, E10}{E9, E10}

Table 3.4 Competence similarities among 10 SMEs (Hajlaoui et al. 2009)

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
E1	0	0.68	0.5	0.7	0.63	0.71	0.69	0.62	0.52	0.64
E2	0.68	0	0.68	0.72	0.56	0.54	0.53	0.34	0.7	0.52
E3	0.5	0.68	0	0.64	0.62	0.62	0.56	0.6	0.62	0.5
E4	0.7	0.72	0.64	0	0.62	0.78	0.79	0.71	0.77	0.66
E5	0.63	0.56	0.62	0.62	0	0.67	0.56	0.59	0.55	0.41
E6	0.71	0.54	0.62	0.78	0.67	0	0.68	0.67	0.79	0.74
E7	0.69	0.53	0.56	0.79	0.56	0.68	0	0.45	0.65	0.46
E8	0.62	0.34	0.6	0.71	0.59	0.67	0.45	0	0.52	0.43
E9	0.52	0.7	0.62	0.77	0.55	0.79	0.65	0.52	0	0.48
E10	0.64	0.52	0.5	0.66	0.41	0.74	0.46	0.43	0.48	0

3.2.2.3 Identifying Potential Cooperation Modes

The last step of the method explained in Sect. 3.2.1 consists in analyzing the cooperation modes among firms, trying to identify RP or reactive networks (RR) (see Table 3.1).

Considering the two sets of clusters obtained by the analysis of complementarity activity fields with similar competencies, we can directly identify the various cooperation modes between pairs of enterprises. Figure 3.6 provides the map of the cooperation modes for the Case Study. This map of the network also underlines possibilities of fusion between given SMEs. This map of cooperation modes can be then further analyzed to suggest the constitution of SME Networks. This Case Study could lead for instance to the following evolutions:

Fusion {E9, E5}
Reactive Networks {E8, E10, E2}
Proactive Network {E5/E9, E4, E1, E3, E6, E7}

However, the results of such decision aid have to be integrated with the individual strategy and visions of the managers.

3.3 Collaboration in Operative Processes

When the focus moves towards the processes that are executed by more enterprises, the analysis of collaboration links is simpler as the collaboration lead to visible and sometimes measurable effects. Examples of processes in a network are mainly the supplying of goods and the demand for them, depending on the fact whether the firm is a client or a supplier. There are many other involved processes like transportation of goods or their storage and, in general, all the logistics processes.

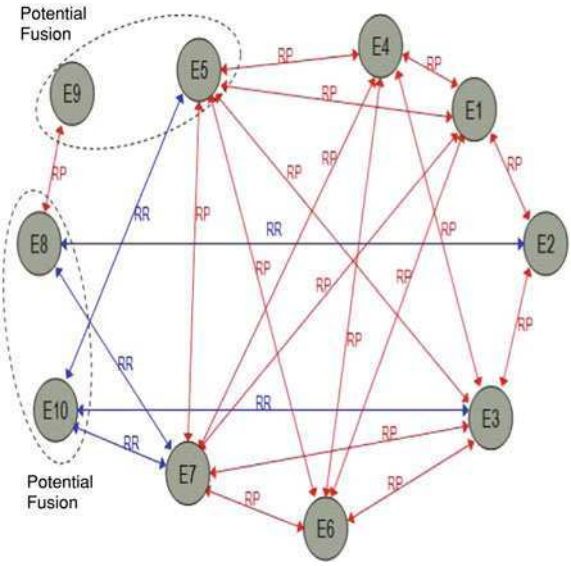

Fig. 3.6 Cooperation modes among companies (Hajlaoui et al. 2009)

Other important processes are connected with the exchange of information among firms by means of ICT tools and the concurrent design of new products with the cooperation of both, the client and the supplier. Without being entangled in the detailed description of the mechanisms and the functioning of every individual process, it is possible to find the actual and potential collaboration activities by using some simple cluster analysis tools.

The problem can be easily defined in this way:

1. Identify groups of enterprises collaborating in a specific process.
2. Analyze the mechanisms and the rules involved in the network operations in order to exploit the advantages of present network organization and possibly to suggest new or different type of associations among enterprises.

Several methods have been proposed in the literature to identify and bind a cluster, involving graph theory, triangularization, factor/principal components analysis for sorting industries into groups based on input–output linkage, as well as statistical cluster analysis. Also optimization methods based on reduction and balancing of transaction costs are available, in theory, in order to recognize the better assets for a cluster of firms.

The main shortcoming of these methods is the difficulty to find the data on which to work. The model proposed here is based on the main requirement of feasibility. The smaller the set of data needed, and the simpler is to find them, the more effective and serviceable is the method. A compelled choice, from this perspective, is a method which considers the network as an input–output system aimed at producing goods or services for the market. The input–output analysis is mainly exploited to deal with the socio-economic and sometimes ecological fields

or in controlling the SC of perishable goods. This work utilizes the production flow analysis (PFA) input–output perspective, widely tested and applied in designing and organizing manufacturing plants, but still neglected in the field of supply network management.

The PFA allows to focus the investigation, preparatory for the clusters identification, exclusively on the quantities of products exchanged among firms.

The objective of this chapter is to describe in formal terms the organization of a CN by taking into account only the inputs and the outputs measured at the extremities of each enterprise considered as a black box.

All the products are processed by means of activities which represent indifferently a production process, a delivering or an added service. Different activities can be assigned to different firms or to the same firm. Only the inputs and the outputs in terms of production volumes are monitored. Inside the enterprise, a number of activities are executed before transferring the products to another enterprise of the SC. Expressed in formal terms, the layout of a network should be organized in order to minimize the production and delivery costs all over the SC, for every product considered.

The new issue is now understanding if the composition of the network which solve the problem (1) is similar or different from the existing industrial structure. By applying methods borrowed by the PFA to the design of the grouping of enterprises in cells, namely the SC, on the basis of production flow similarities, we will compare the real industrial solution with the virtual network organization resulting from the PFA analysis and we will highlight the differences between the two. They are usually due to three main aspects:

- The official SC are aggregations among firms linked by contracts and restrictions which could overcome the real SC as it emerges from the analysis of production flows.
- The companies inside the networks suffer by information asymmetry, because usually information is passed only between two adjacent nodes of the networks and therefore the chosen SC is poorly designed.
- The model cannot take into account the history of the network, some geographic peculiarity, like national borders, lack of proper connections and economic issues, like labor cost which could make convenient, the participation of a firm to a SC despite a geographic penalty.

The last is the very case of many suppliers in the automotive SC of a main car manufacturer. Generalized delocalization of production, combined with a lower labor cost in the far east countries forced many suppliers to join SC on the very other side of the Earth, despite the costs and the coordination issues consequent to such large distances.

Let us suppose to be provided of a process routing sheet (PRS) (see Table 3.5).

Every part to be produced is decomposed in a sequence of activities and every activity has been assigned to a different firm. From now on, for sake of simplicity, the number assigned to an activity is representative of a correspondent firm too. In a more detailed case groups of activities are executed from different firms.

Table 3.5 Process routing sheet

Part	Activity list	Demand
1	1, 7	100
2	2, 6	1,500
3	8, 1, 3	80
4	5, 4, 7	350
5	1, 8	3,400
6	2	200
7	4, 7, 8	200

Table 3.6 Incidence matrix corresponding to the PRS

Firm product	F1	F2	F3	F4	F5	F6	F7	F8
P1	1						1	
P2		1				1		
P3	1		1					1
P4				1	1		1	
P5	1							1
P6		1						
P7				1			1	1

The sequence is ordered and therefore from the PRS it is possible to follow the flow along the SC. Also the demand for every part is known but no information is available about lead times and costs. This is the typical kind of data which is possible to extract from a public data base.

If every activity is executed by a different firm, the parts and the firms can be represented on an incidence matrix, where the non-zero cells express the fact that the part is effectively worked inside the firm. Table 3.6 represents a Boolean incidence matrix for the PRS of Table 3.5.

The first problem to be solved is the identification of the 'natural networks', i.e., group of enterprises which act as a network independently from the existence or less of contractual bounds among each other. We apply some clustering procedures like those that are available in every statistic package. These procedures extract from the main matrix, a sub-matrix strongly interconnected. We obtain the solution represented in Table 3.7.

In a nutshell, the cell formation strategy performs its objective, by finding the group of rows and columns which satisfy the following constraints:

- Independency among different cells.
- Singular cells should minimize the inter-cell flow.
- The sub-matrix dimension should be kept under control.

In the classic theory of PFA the 'singular cells' represent the parts which have to be worked by two different working groups or outside the factory through subcontracting. In our application the 'singular cells' are not a great issue, simply representing the enterprises which belong to two different industry networks, which is the case of a firm whose production covers different market typologies.

Table 3.7 Network identification matrix

Firm product	F1	F8	F3	F2	F6	F4	F5	F7	Demand
P3	2	1	3						80
P1	1							*2*	100
P5	1	2							3,400
P2				1	2				1,500
P6				1					200
P4						2	1	3	350
P7		*3*				1		3	200
Work-load	3,480	1,700	80	550	350	1,600	550	3,680	

The method allows the recognition of three groups of enterprises, not tightly isolated to each other. The first is composed by firms F1, F8 and F3, exchanging products P3 and P5 within the cluster and P1 and P7 with the outside (with the third cluster particularly). The second cluster is composed of F2 and F6, exchanging P2 each others, while P6 is simply processed by F2 but not exchanged within the network. The third identified network is composed by F4, F5, and F7, exchanging P4 and P7 within the network itself and with the first network as well, while P1 is processed by F7 for the first network.

Table 3.8 represents clearly show the relations among cluster composition and products exchanged among firms. Empty lines and columns point out, respectively, firms receiving (providing) products only from (to) the network outside, see F2 and F6.

Table 3.8 represents the starting point for the PFA, referring specifically to the role of each firm within his cluster. Table 3.8 allows to recognize in a simpler way two types of enterprises and, depending on their distribution, two types of network organization structures as well.

Table 3.8 Production flow analysis of the network

Down-firm	Up-firm								Incom. flow	(From outside)
	F1	F8	F3	F2	F6	F4	F5	F7		
F1		P3							80	
F8	P5							*P7*	3,700	(200)
F3	P3								80	
F2										
F6				P2					1,500	
F4										
F5							P4		350	
F7	*P1*					P4, P7			550	
Outcom. flow (to outside)	3,580 (100)	80		1,500		430	350	200		

Enterprises could be differentiated as primary and secondary according to their relative weight in their network of interactions. Primary enterprises are characterized by a larger flow incoming or outgoing within the network and towards others firms (said secondary). A network could be composed of a single primary enterprise and a set of secondary ones, or, as in the first network of the example presented in the previous chapter, by a primary link, that is two (or possibly more than two) enterprises exchanging the larger percentage of the cluster flow (F1, F8 in the example). The primary enterprises have usually the bigger production capacity in the network and probably they also manage the link with other clusters, when they exist.

Some hypothesis about the networks organization structure could be derived. The organization structure refers to the decision-making processes in the administration of the network (who takes decisions? who decides the volumes exchanged, the prices?). When a single primary industry exists, the network has a hierarchical organization, while in the second case his structure is said to be polycentric. When, on the contrary, no significant difference can be recognized in the flows incoming and out coming from firms belonging to the network, the network itself is said to be canonical.

In a hierarchical network, the primary firm plays a role of main coordinator and leader of production, distribution, and innovation processes. Secondary firms work in single-commitment way, and their existence depend on the primary industry capability of gaining market share nearby the end customer. The potential role of public institution in supporting this kind of network is very narrow, at least until the secondary enterprises stay under the leader's shadow.

In a polycentric governance structure each primary industry is called to coordinate itself with both its sub-network of secondary partners (in the simple exemplification F8–F3) and with the other primary firms (F1–F8). This type of organization typically characterizes products with a high degree of technological features, where the cognitive partition of the labor is crucial. The role of public organizations could be significant in assisting the primary firms in their role of multiple coordinators.

The canonical cluster refers to the typical SC structure. It is composed by a network of demand and supply relationships centered in the production of the same type of end-product. The network is nearly balanced, sufficiently open to the outside, highly socially and territorially characterized, and not very strong neither formal relationships exist among firms. They are rather put together by usual links strengthened by the physical and cultural closeness. Typically these networks produce high quality products, highly related to the resources (both material and not) available in the region. Public institutions have the crucial role of defending the tricky existence of both products and enterprises assisting them in critical matters of intellectual property, trademarks, marketing, and innovation (assisting, for example, the creation of common laboratory of research or technological consulting).

The organizational structure deduced or recognized with this method must be necessarily supported by other considerations, taking into account the historical

and social skill of the network, the cognitive organization of work, and different interdisciplinary aspects.

3.3.1 Application Example: A Wine Industrial District

Industrial Districts are a specific kind of industrial networks recognized firstly in Italy where they are most spread but usually present in many other countries. Becattini (1990) defines the industrial district as a socio-territorial entity characterized by the concurrent presence, in a confined territory, of a community of workers and of a population of industrial enterprises. Usually people working in an industrial district feel to be part of a community. Enterprises inside a district are usually specialized in different, often complementary productions belonging to the same industrial sector in such a way, to be able to create a self consistent SC inside the ID. This situation allows a wide degree of flexibility and product differentiation. As ID receive a consistent financial support from the public administrations, it is important to determine accurately if a determined territory be a true District.

A first survey of the ID in the Piedmont Region was prepared by the national statistical agency ISTAT (deliberation of the Regional Council, 18/06/1996 n. 250-9458) and was based on the analysis of the average travel distance between home-work. The number of Districts was stated as 87 and was eventually reduced to a final 25 by applying the following filters: industrialization indexes, industry density and specialization in a single sector, percentage number of SMEs, and their relevance in the sector, as described in Table 3.9.

We use as an example the ID of Canelli and Santo Stefano Belbo, between the Cuneo and Asti provinces (see Fig. 3.7).

The area owes its notoriety to the 'Moscato' (a sparkling wine) and is specialized in projects connected to the wine brewery. The main product is the 'Asti Spumante' but the ID covers all the activities of the wine weaving factory, from wine growing to fermentation, to production of wine machinery. More than 30 firms are involved in the production of machines. The ID is a network, vertically organized and is characterized by strong links between a few of leader enterprises and a large amount of small agricultural. Nevertheless, present levels of automation and mechanization also allow the SMEs to be involved in almost any production phase. Available data have been analyzed starting from the process plan of the wine bottles, described in Fig. 3.8.

Table 3.9 Evaluation index for the district status assignment

Evaluation index	Threshold
Industrialization (% workforce)	> 44% of the national value
Density of manufacturing enterprises	> 10% of the national average
Productive specialization (% workforce)	> 20% of the national value
Weight of SMEs in the sector (% SME workforce)	> 50%

Fig. 3.7 The area of Moscato cultivation

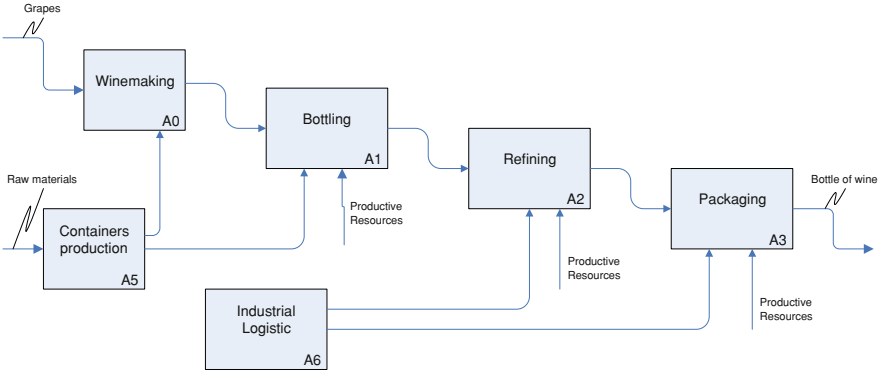

Fig. 3.8 Scheme of the process plan

In the Canelli ID, the applied method for producing sparkling wine is derived by the well known method Champenoise. With this method, the bubbles for more complex wines are produced by secondary fermentation in the bottle (and not in the barrel). After the grape harvest, grapes are pressed in order to obtain the must, that is decanted in barrel. After this phase and the bottling, a second alcoholic fermentation occurs in the bottle. This second fermentation is induced, adding several grams of yeast and several grams of rock sugar; the must starts its fermentation at low temperature (18/20°C) for at the most 25 days. The champagne bottle is capped with a crown cap. The bottle is then riddled so that the lees settle in the neck of the wine bottle. The neck is then frozen, and the cap removed.

The pressure in the bottle forces out the lees, and the bottle is quickly corked not to loose the carbon dioxide in solution.

The process plan is therefore made of

- Harvesting: in the Canelli ID, this phase still takes place through traditional methods, so it marginally involves the eno-mechanical sector. For this reason, in the ID, there are just two enterprises whose sector activity is the vineyard technology.
- First fermentation: produces the base wine. At this point the blend, known as the cuvée, is assembled, using wines from various vineyards. Enterprises involved in this phase are: L'Enotecnica, Montanaro F.lli, Sirio Aliberti e Turco.
- Second fermentation: the blended wine is put in bottles along with yeast and a small amount of sugar for a second fermentation. During the secondary fermentation the carbon dioxide is trapped in the bottle, keeping it dissolved in the wine. The amount of added sugar will determine the pressure of the bottle.
- Riddling: after aging, the sediment (lees) must be consolidated for removal. The bottles undergo a process known as riddling. In this stage the bottles are placed on special racks at 45° with the floor, cork pointed down. Every few days the bottles are given a slight shake. This manual way of riddling sparkling wine has been largely abandoned because of the high labor costs. Mechanised riddling equipment called gyropalettes are used instead.
- Disgorging is another operation, now automated by freezing the neck of the bottle and removing the plug of ice containing the lees. Dosage is made immediately after disgorging but before corking. The most part of the ID enterprises are involved in this phase.
- Labeling involves Cavagnino and Gatti, Cirio Germano, Enos, Eticap System, Menabreaz-Ivaldi, O.M.B., P&P Production, S.T.S. Savino.
- Packaging involves Campia Imballaggi, Mimi, Serra Impianti, Tosa.

Enterprises of the Industrial District of Canelli provide also for the production of wine containers, barrels, corks, caps, tools necessary for production and bottling of the wine. This activity is executed by Alplast, Araldo Paolo, Belbo sugheri, Ilas, Intercap, Rossi. There are also enterprises that provide tools necessary for the logistic and transport in the line production. Enterprises involved in activities like production of conveyor belts are: Bieffe, Dogliotti, Fillpack, Mas-Pack, Mondo & Scaglione. Some other enterprises are involved in supplying materials and, supporting production and marketing: Euro Beta, Ferrero Ugo & Fabrizio, F.lli Ferrero, Marmo, Revello Giovanni, Tea-Inox, Technology BSA, Tecnoidustrial Amandola, Tra.Sped.

Enterprises could already be disposed in a taxonomy, belonging to one stage of the process plan, corresponding directly to the enterprise output. Nevertheless, a typical SME's structure is by far different and usually simpler than what appears. Therefore it is noteworthy to test if the clustering of the enterprises based on their production–process plan correlation matches the official taxonomy.

The available data consist in a incidence matrix, named enterprises–activities matrix, containing binary information about production or services activities in

the ID. Rows of the matrix correspond to ID enterprises, while columns correspond to the activities performed in the district area. Cluster analysis was used to investigate grouping in data, simultaneously over a variety of scales, by minimizing a suitable distance among the data. The distance function should give a way to measure similarity between two firms. Hierarchical clustering was chosen as the more appropriate technique for working with categorical variables. The decision of the most appropriate level of clustering is found by choosing the threshold of the inconsistency coefficient for each link of the hierarchical cluster tree. Before applying the hierarchical clustering to the incidence matrix, a binary sorting has to be executed in order to separate and exclude the white rows and columns (Table 3.10)

These represent firms which produce independently from all the others. Probably most of them are inside the geographical boundary of the district by mere chance. The fact is that their production is anyway in the oenological sector, therefore the choice of recurring to outside firms for their SC cannot be imputed to chance but means the opposite of collaboration: disagreement with the objectives of the district.

Considering the production cycle presented in Fig. 3.8, we constructed a second matrix, containing a row for each activity performed in the district and a column for each phase of the production (Table 3.11).

Multiplying the two matrices, we obtained a new matrix with a number of rows equal to the number of enterprises and a number of column equal to the number of phases in the production cycle. In the cells of the matrix there are values different from 'zero' when the activities of the *i*th enterprise are a part of the *j*th production phase. Performing the cluster analysis with this matrix, results are more suitable for our purpose of clusterization. Figure 3.9 illustrates the dendrogram of clusters made by applying the hierarchical clustering with Hamming distance as shown in Sect. 3.2.

Analyzing the dendrogram obtained from the clusterization we obtain 18 clusters with a maximum number of five enterprises for cluster and with only one cluster with just an isolated enterprise. The coefficient of consistency is 0.8582 that is higher than the coefficient obtained in the first analysis considering the enterprises–activities matrix (Fig. 3.9).

For instance, let us consider cluster number six, grouping enterprises Bieffe, Dogliotti, Fillpack, Mas-Pack and Tra.sped, verifying their activities in the production cycle, they are all involved in the supporting activity to the production of industrial logistic. Cluster number 14, grouping five enterprises, Clifom, Gierre, Serra Impianti, Tosa, Mondo & Scaglione that have an important role in the bottling phase, producing caps and washing and filling machines. Presently the exchange of information among these enterprises is limited with respect to their potential.

The conclusion is therefore that it is possible to make an analysis of the potential collaboration structures existing among firms in a CN. The analysis is performed both at a strategic level and at a operative level. The adopted methodology is easy and universal, thus its implementation required some stochastic

Table 3.10 Enterprises–activities matrix

	Vineyard technology	Cellar implements and accessories	Manufacturing and overhaul of enological machinery	Pumps and electric pumps	Filtrl e piastre micro-filtranti	Flour strainer filtering machines, filter with clothes	Machines for cork factory	Pressure tanks, tanks and cistern wine making containers	Filtering cartons and cartridges crush filters	Barrels, casks and vats	Rinsing machines	Blowing machines	Wash spin dryer machines, elevators, canalizing/ feeding machines	Bottle outside washing and drying machines
Colombardo Mauro	1													
Olmi	1													
L'Enotecnica		1												
Montanaro f.li					1									
Sirio Aliberti								1						
Turco		1				1			1					
Arol														
Borelli group											1			
Cimec														
Clifom											1			
Enolmeccanica Vallebelbo														
Eurostar											1			
Fimer														
Gai											1			1
Gierre											1			
Martini Costruzioni														
Mesiano Nazzareno											1			
Neri Filippo							1						1	
⋮														

Table 3.11 Phases–activities matrix

	Vineyard technology	Cellar implements and accessories	Manufacturing and overhaul of enological machinery	Micro filtering plate strainer manufacture and custom made installations	Flour strainer filtering machines, filter with clothes	Pressure tanks tanks and cistern wine making containers	Filtering cartons and cartridges crush filters	Barrels, casks and vats	Blowing machines	Bottle outside washing and drying machines
Viticoltura	1	0	0	0	0	0	0	0	0	0
Lavorazione vino	0	1	1	1	1	1	1	1	1	1
Imbottigliamento	0	0	0	0	0	0	0	0	0	0
Rifinitura commerciale bottiglie	0	0	0	0	0	0	0	0	0	0
Imballaggio e confezionamento	0	0	0	0	0	0	0	0	0	0
Movimentazione Industriale	0	0	0	0	0	0	0	0	0	0
Materiale/Attivitá di sviluppo	0	0	0	0	0	0	0	0	0	0

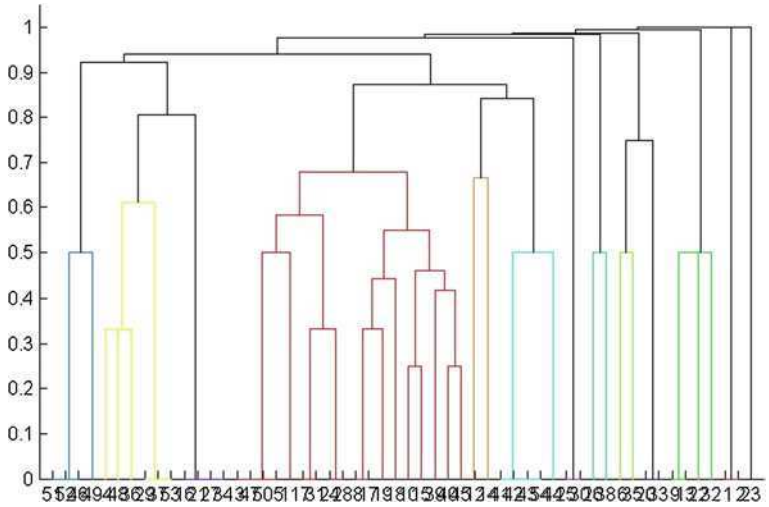

Fig. 3.9 The dendrogram showing the clustering of firms based on potential collaboration link

ingenuity that is now embedded in existing (still non-commercial) software applications.

Credits All the authors wrote Sect. 3.1, D. Antonelli wrote Sect. 3.3, X. Boucher and Patrick Bourlat wrote Sect. 3.2.

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Chapter 4
SME Networks and Clusters: An Approach for Their Performance Evaluation

Agostino Villa and Teresa Taurino

Abstract By analyzing public data on more than 120 SME clusters from 11 different countries of Europe, the CODESNET project got some interesting information, sometime unexpected and sometime foreseeable. Among them, about 50% of the analyzed clusters show a clear division of labor among the partners but only one-third can afford a dedicated ICT support; another 50% show a high improvement potential and can be found in the middle success category; there can be found different categories of clusters: on the one hand a network can be agglomerated in a relatively narrow area (rural district, county); on the other hand a network can consist of firms with a dilatation over a whole nation or (but rarely) over Europe. These types of information revealed to be of real utility for managers of SME clusters and supply chains. So, in developing the project, it was necessary to introduce a standardized format for describing the main characters of the analyzed industrial bodies, by using public data. This chapter aims to give a description of that standard format for data collection and storage, and the conceptual model of SME cluster by which said format has been derived. Any data repository, indeed, cannot be really used for any evaluation if a clear model of the systems from which data are extracted, has clearly stated in advance.

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4.1 The CODESNET Approach to SME Cluster Performance Evaluation

In the research activities of the 6th Framework Programme, the EU-funded Coordination Action, named CODESNET (Collaborative Demand and Supply NETworks, for information see the web site www.codesnet.polito.it), became the intellectual ambient in which the problem of how to estimate the performance level of a cluster of SMEs, and how to select the most useful information and data for deriving a significant estimation, have been approached by a group of 22 institutions, partly universities, research centers and SMEs.

Soon, a strong constraint became necessary for what concerns the data collection: "data must be public", that means they must be collected and selected from public documents, as non protected web sites. This has been recognized as the condition by which a free evaluation of industrial bodies could be done.

Typically, this constraint reflected into a compressed set of usable data, sometime quantitative but more often qualitative. The data restriction forced the CODESNET consortium to develop a more and more efficient procedure for performance evaluation, according to two lines. On one hand, a performance evaluator should have at its disposal a standard conceptual model of a SME cluster such that all considerations which could be derived from a few data, could have the most significant interpretation in the light of such a model. On the other hand, the same standard conceptual model could be used as the "descriptor" of the basic components of any SME cluster, such that all collectable data could be referred to anyone of the cluster components; if so, a corresponding standard format for data collection should be defined.

Guided by these two ideas, the development of a simple but sufficiently detailed model of a SME cluster became the first goal of the CODESNET project.[1] The content of this chapter is based on the results obtained during the development of said EU-funded project.

The first approach has been that of characterizing a SME cluster by some principal features:

1. A common economy, with specialized production of one type of good or service;
2. An extended division of labor between firms;
3. Many direct relations with each other;
4. Sometimes, a climate of trust and cooperation.

According to these features, a conceptual model of a SME cluster can be viewed as a graph of (that means, a network of connections among) partially

[1] The work presented in this chapter has been derived from the results obtained during the EU Coordination Action (CA) *CODESNET*, project n° IST-2002-506673/Joint Call IST-NMP-1, 2004–2008.

autonomous firms, i.e. firms which agree to be collaborative together. In this light, collaboration refers to the following potential interactions,

- to have a high rate of reciprocal transactions concerning components and products,
- to share information and common services,
- to define together common industrial strategies (as in case of joint projects to search for a new market, to develop either a new technology or a new product, and to organize new logistic services).

These preliminary considerations give useful hints for identifying some viewpoints according to which a SME cluster analysis could be arranged. In summary, they suggest three complementary viewpoints:

1. Analyze the production and logistic network which are connecting the collaborative SMEs, that means to analyze the distribution of production operations among SMEs, the type of logistic organization, the production capacities of SMEs, and to estimate how the network organization can improve the production volumes of the different SMEs, the amount of personnel employed at the different SMEs, the transport capacities over the internal logistic network.
2. Analyze the governance organization, that means to analyze the management responsibility attributed to each SME and the amount of information that each SME has at its own disposal for management purpose (i.e. how the decisional power is attributed), the types of internal agreements and control mechanisms, and the types of agreements with external bodies; and to estimate the characters of the organization chart at the network level, the functionality of the coordination body, if any, and the coordination strategies.
3. Analyze the network interactions of SMEs with outside, that means to analyze the types of commercial agreements with clients/suppliers, the types of strategies to manage, at the network level, both production resources and labor, the types of policies to plan, at the network level, innovation programs; and to estimate the dynamic evolutions of the market penetration, the labor employment, the risk capital acquisitions.

These three analysis viewpoints, respectively correspond to three specific basic functions which the network of SMEs usually perform, namely: (1) produce; (2) manage; (3) negotiate with suppliers, customers, potential financiers, and potential employees. Above three viewpoints for analyzing a SME cluster can also be considered as referring to three corresponding parts of any cluster, which are: (i) the "Operation Structure", i.e. the network of physical and information connections among the SMEs inside the cluster, with each enterprise being a node of the network itself; (ii) the "Organization Arrangement", i.e. the over-head governance organization; (iii) the "Interactions with the external Socio-Economic Environment", i.e. the cluster services devoted to negotiate with the external markets.

In more detail, the *Operation Structure, OS* refers to the graph of interactions linking the enterprises together, through flow of parts, information & controls, money; each node of this graph is an autonomous enterprise, and plays the role of

an individual decision-maker (DM), in turn included into a "group of companion DMs", all composing the cluster. The second part, the *Organization Arrangement, OA*, (i.e. the network governance) refers to the over-firms organization devoted to managing cooperation of the enterprises together; in principle, its scope is to harmonize the production/service plans of the different enterprises such that the delivery of final products to the output markets could match the demand. And the third part, the *Interactions with the Socio-Economic Environment*, *ISEE*, refers to the output interface towards external markets (which usually is a part of the governance organization, but here is evidenced by alone in order to emphasize its crucial role in an industrial network); in principle, its scope is to make as strong as possible the presence of the industrial network in the markets of final products, labor, finance, etc.

The structured representation of a SME cluster by means of its three basic components gives a clear direction towards two of the most significant analysis goals, in practice, namely:

First goal: identify which interactions exist among the SMEs in the network, so as to recognize the "leading SME", if any;

Second goal: verify the type of Organization Arrangement (i.e. the network governance) and its adequacy to manage the set of connected SMEs under study.

It looks clear to any practitioner that these two analysis goals could allow managers of SMEs to have a clear view of the type and strength of the cluster organization and management. Then, it can clarify the robustness of the cluster itself.

To answer the above two points, one can recognize that some analysis steps could be performed: the first two steps can be operated to evaluate if existence of a leading firm could enforce the cluster, whilst the third step should allow to estimate the robustness of the cluster governance.

1. The first step consists of recognizing the "principal production flows" among SMEs through application of the Production Flow Analysis, a simple procedure to represent the main production flows over the network of physical connections among the SMEs of the cluster, and to compute the average production load at each SME, as the sum of the production flows converging on the SME itself (for more details, see the book by Burbidge 1989);
2. The second step is the recognition of the leading SMEs through identification of the principal SME, namely the one with the greatest number of incoming production flows;
3. The third step consists of validation of the organizational chart of the SME network, if any, by means of two considerations:
   a. by analyzing the existence of management and cooperation strategies among the SME groups;
   b. by analyzing the coordination strategies devoted to control the individual actions to increase profit and competition.

The outlined set of analysis steps can be transferred into practice if a standardized procedure for collecting "certified" data has been made available to the

SME cluster analyzer, where "certified" data means "public" data (the unique way to assure certification of information concerning enterprises), including a standard catalog of the main issues concerning SME clusters (i.e. design, management, and evaluation aspects and problems), such that the analyzer could recognize at least one SME cluster representing a benchmark or a "best practice" in a specific issue and industrial sector. The next section will describe the standard format to collect data on SME clusters, designed according to the idea on which the three viewpoints for cluster analysis (and the three related cluster component parts) have been introduced.

4.2 The Standard Data Collection Format V-LAB

The standardized collection of data describing a SME cluster, developed during the CODESNET project period, has to organize information according to the three component parts of the conceptual model of the clusters themselves, that are the network of interactions connecting the SMEs inside the cluster (Operation Structure, OS), the network governance (Organization Arrangement, OA), and the management of interactions with outside (Interactions with the Socio-Economic Environment, ISEE).

The resulting format, denoted V-LAB (Virtual Laboratory sample), includes a first table of data/information that aim to answer the following questions related to the Operation Structure of the cluster under examination:

1. *how are production operations & volumes distributed among the enterprises composing the cluster;*
2. *which are the main skills employed in the ID SMEs;*
3. *which is the logistic system connecting the ID SMEs.*

To evaluate the first point, (i.e. production and distribution among the enterprises), attention must be focused on the production type and on the specialization of production for each individual enterprise. Two existing formal supports can be used to help the analyzer in giving a clear answer to the first question: representing the structure of the product by the "product three" of all components and their gradual assembling, and illustrating the "cluster layout", that means the network of physical connections among the SMEs (see Villa 2006[2]). The information and data useful for performing this first analysis step are catalogued in the V-LAB sector referred to the cluster Operation Structure.

[2] More details on the models and procedures that can be used for simply analyzing data and information contained in the V-LAB format, and above briefly outlined, the reader can refer to the book by Villa (2006).

For the second aspect, concerning the skills employed in the network, attention must be focused on the expertise (i.e. skill competence profile) evaluated using a map of the intellectual capital of personnel. In summary, the skill of an employee is represented by a list of specific knowledge and ability (what the person knows and what is able to do, in the industrial ambience where he/she is working). A table including all these lists gives a clear view of the set of knowledge and ability attributes which the enterprise is provided.

In order to establish the logistic system that connects the enterprises belonging to the industrial network; production flows, queues, and transportation systems must be considered using the classic flow and queues models widely studied in the frame of Operations Research (see Hillier 2009).

From this analysis the following set of performance indicators results:

1. *number of SMEs*: number of Small end Medium Enterprises belonging to the industrial network;
2. *number of employed personnel*: number of persons employed in the industrial network;
3. *percentage of outsourcing*: percentage of the entire production process developed outside the district area;
4. *percentage of external suppliers*: percentage of parts or service necessary for the production and received by external suppliers;
5. *percentage of acquired know–how*: percentage of competencies acquired from external actors (i.e. consulting);
6. *flow time*: period required for completing the production process;
7. *WIP (Work In Process)*: partially completed goods, parts, or subassemblies that are no longer part of the raw materials inventory and not yet part of the finished products inventory;
8. *resource utilization*: number of billable hours divided by the number of hours recorded in a particular time period.

Intuitively, this set of indicators can give a significant help to the analyzer in estimating the efficiency level of the Operation Structure, that means in evaluating how much the cluster depends on external production resources and know–how (indicators 3, 4, and 5), how efficient is the production (indicators 6, 7, and 8), while the first two indicators give a flavor of the cluster dimension.

Referring to the Organizational Arrangement, the V-LAB format supports in analyzing the following three aspects of interest:

1. *how are the cluster's responsibilities attributed to SMEs;*
2. *which are internal agreements of SMEs together;*
3. *which is the cluster organization strategy.*

To evaluate the first point, the attention must be focused on the existence of a leading firm in the organizational chart. The leading firm is, usually, an enterprise bigger than the others in the network, that can guide the decision process.

If a leader cannot be recognized, attention must be addressed to the existence and the type of a "governance" committee. In this case, the analyst has to

investigate the presence of coordination and cooperation relationships among the enterprises, and the decisional levels in the envisaged network organization must be considered.

Based on these data and information (re to the V-LAB sector on Organization Arrangement), it's possible to find the following set of performance indicators:

1. *existence of a leading firm*: if it's possible to identify a leader among the enterprises in the network;
2. *completeness of the agreement chart*: an indication of the completeness of the chart of agreements among enterprises, mainly concerning communication and relations links;
3. *lead time of the decisional process*: time required, in the average, to adopt strategic management decisions involving all enterprises;
4. *percentage of not attained objectives*: percentage of production objectives not attained at the end of a specific period;

This second step of indicators has a clear scope: to give hints about the robustness of the coordination of the enterprises actions in the clusters, and the ability of cluster, as a whole, to decide. Indeed, these two characters are of prevailing importance in cluster management, owing to the growing decisional speed required in industrial transactions.

In order to evaluate the Interaction with Socio-Economical Environment (third part of the V-LAB format), three aspects of interest can be taken into account:

1. *which are commercial agreements stipulated with external bodies;*
2. *is a cluster innovation program applied;*
3. *which could be the cluster future evolution.*

To evaluate the first point, attention must be focused on the existence of a commercial structure, as an agency inside the cluster, with the scope of finding clients and suppliers and to promote the network activity in the appropriate market.

For the second aspect the attention must be focused on the existence of technological innovation plans, that are clear signals of the innovative nature of the network both in terms of innovation of product and innovation of process, as well as on the attention that the cluster dedicates to long-life educational programs for the personnel. The evaluation can be done using models of market research and cost management, and models of knowledge management (for more information, see Holsapple 2003).

These third analysis step aims to support the estimation of the following set of performance indicators:

1. *annual sales*: amount of sales in a period of a year;
2. *percentage of export*: percentage of production for external market;
3. *percentage of market coverage*: percentage of sales over the total sales in the internal market;
4. *number of patents*: number of patents in order to evaluate the innovative power;

5. *percentage of resources (personnel) in RTD*: the RTD magnitude with respect to the network dimension;
6. *life-long education plans*: if there are, periodically, education, and refresher courses.

This third set of performance indicators is self-explaining for any industrial manager. However, some comments could give further help. The first three indicators aim to offer a view of the market penetration, thus giving an idea of the robustness of the cluster. Indicator 4 gives a really important suggestion: how strong is the cluster in terms of proprietary knowledge. This information must be confirmed by the following two: how great is the percentage of personnel dedicated to research and development, and how frequent are the life-long learning courses.

The V-LAB format (an example is reported in appendix) has been thought to follow the logic of analysis steps above described, and has been based on the three components (and related viewpoints) of the outlined cluster conceptual model.

A simple overview of the V-LAB format allows to see a first part that is a description of the industrial reality, with a particular attention to references necessary to keep a contact with the industrial reality itself. It is completed by a series of keywords useful to label the industrial cluster (Fig. 4.3 in appendix).

The purpose is also to make the reader to understand why the network described is important, then a short list of keywords and issues to identify the network activity, is presented. The three aspects underlined in this list of characteristics are type of product, sector of activities, and terms of process as illustrated in Fig. 4.4.

In the following, to give immediately an overview of the industrial network, a short description of the network, its production, and organization is required, in order to allow the reader to immediately evaluate his/her interest in the information contained in the V-LAB (Figs. 4.5 and 4.6). In addition, as shown in Fig. 4.7, general information include network type, typology of the skill employed, percentage of market covered, while "Performance Indicators" refers to estimation of annual sales, export volume.

After the "network overview", each dimension of the meta-model have been detailed, following the above presented list of three groups of questions, in order to provide to readers as complete as possible, a description of the system. Data and information collected there are included in the V-LAB sectors illustrated in Figs. 4.8, 4.9, and 4.10.

Based on the V-LAB formats collected during the development of the CODESNET project, the following section will present an overview of a performance evaluation of a SME cluster currently stored in the CODESNET web site repository: the Austrian Ökoenergie-Cluster, specialized in sustainable energy. In appendix, the related V-LAB format is reported, such as to give readers all data and information sufficient to have a clear view of all analysis considerations of the next section.

4.3 An Example of Cluster Performance Evaluation: Analysis of the Ökoenergie-Cluster (Sustainable Energy-Cluster) Upper Austria[3]

Starting from data and information collected in the V-LAB (see Figs. 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.10), it is presented now as an example of Network description. The SMEs Network examined is the ÖkoEnergie-Cluster, OEC (Sustainable Energy-Cluster) in the Upper Austria, a highly industrialized region in the Northern part of Austria. The OEC cluster businesses cover the whole eco-energy industry, from the production of renewable energy technologies to the installation, consumption (energy efficiency), and related services.

The OEC cluster was established in March 2000: at the moment 146 companies and organizations from Upper Austria and recently 37 partners from South Bohemia (administrative district of Czech Republic) joined the cluster. The cluster is not formed by some big leaders surrounded by SMEs depending on them, but by large, medium, and small highly competitive companies and organizations.

The *Operation Structure* of Ökoenergie-Cluster includes all actors playing in the green-energy field as a whole from the production of renewable energy technologies to the installation, consumption (energy efficiency), and related services. As shown in Fig. 4.1, the cluster Operational Structure includes the following type of companies and organizations:

- SMEs producing components (V): components for biomass heating systems, components for small hydro power plants, components for windparks, control systems, photovoltaic components, etc.
- SMEs producing final products (W): wood pellet stoves, solar collectors, heat pumps, zero energy houses, wood pellets/chips heating systems, tiled stoves, etc.
- SMEs providing installation services (X): biogas installations, photovoltaic installations, windparks installations, ventilation systems for domestic applications, etc.
- SMEs providing services in the energy field (Y): building thermography, energy advice, feasibility studies, third party financing, etc.
- Organizations providing knowledge (Z): universities, research centers, and training centers.

The material flow involves "Component" (V), "Product" (W) and "Installation" (X) SMEs; "Installation" (X) companies are dependent but can also influence companies (V) and (W) for local market. Since cluster export rate is >50% (mostly European counties) "Product" and "Component" companies are relatively

[3] The cluster performance analysis presented in this section has been partly developed by Mr. Clemente Magnago—clemente.magnago@gmail.com, during his participation in the PH course on "Analysis of industrial processes II", IV Faculty of Engineeing, Politecnico di Torino, taught by Prof. A. Villa.

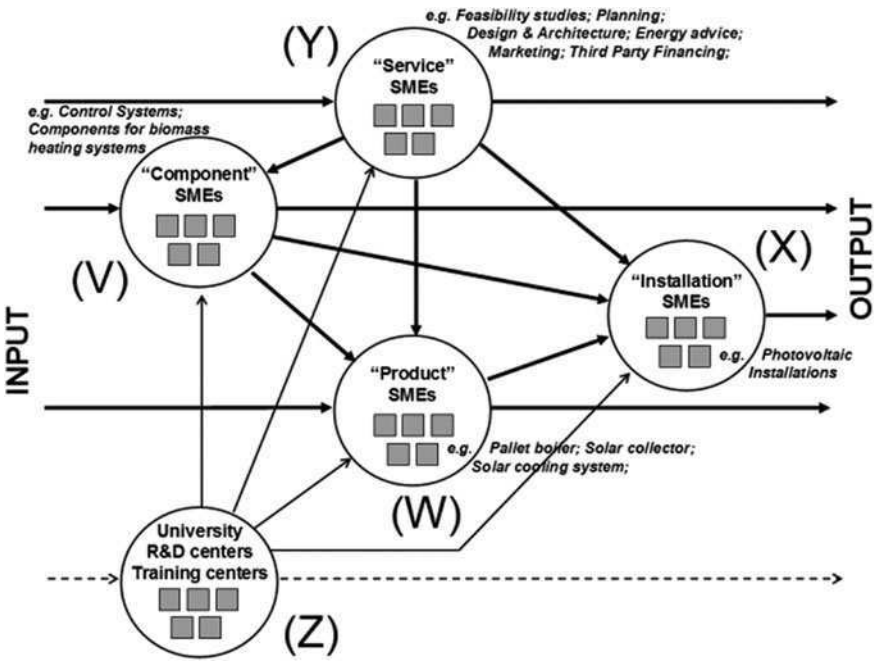


Fig. 4.1 Ökoenergie-cluster operational structure

dependent from the local regional market, also these companies are the ones influencing the cluster development dynamics. It is important to notice the importance for cluster development, of "soft-skills" services provided by "Service" SMEs (Y) and "Universities and R&D" (Z). The Operation Structure, not being simply a network of companies building products for the sustainable energy market, but including all complementary competences for this sector and not having big leader companies surrounded by SMEs, but having all SMEs highly innovative and competitive companies, can be considered as one of the strong points of the cluster.

The *Organization Arrangement* of the OEC cluster (E) is based on the fact that the OEC is managed by the O.Ö. Energiesparverband ESV—Energy Agency of Upper Austria (D) that reports to and is financially supported by the Regional Government/Department of Economics of Upper Austria (C) which regarding the application of sustainable eco-energy directives reports to the Austrian Government (B) and to the European Union (A). Cluster companies (F) for simplicity are grouped by activity. The Energy Agency (D), is organized as a non-profit association with 31 members including energy suppliers, energy consultancies, environmental groups, professional associations, and firms involved in energy technology and the Upper Austrian government (see Fig. 4.2).

The ESV Energy Agency (D), supports the development of local sustainable energy market by prompting, activities on the "Products Production" side (E) the

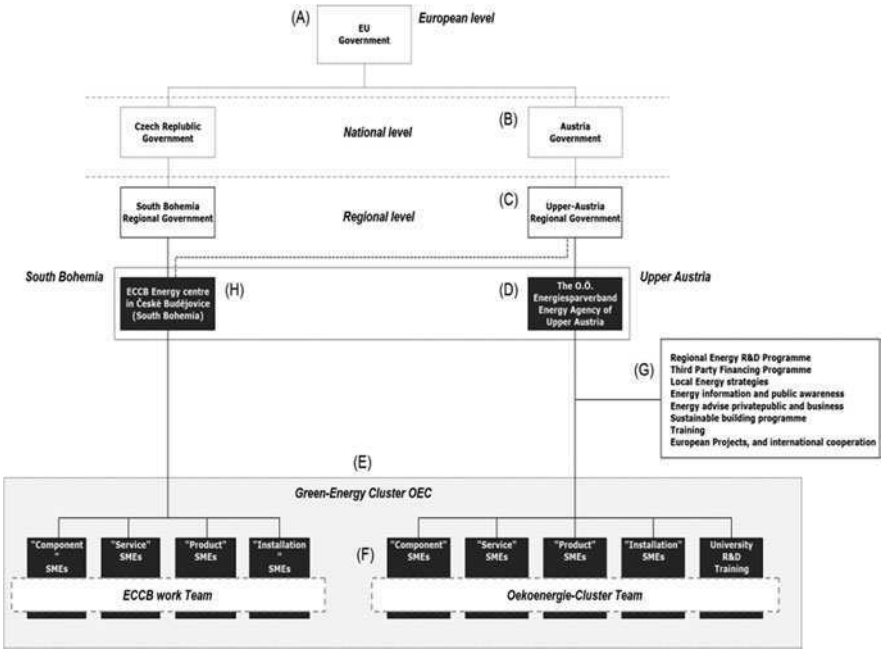


Fig. 4.2 Ökoenergie-cluster organization arrangement

OEC Cluster businesses via the OEC-Cluster team, and the local "Products Demand" side (G) supporting the Regional Government (D) in the development and implementation of regional energy programs.

Regarding the "Product Demand" goal, the focus is on reducing energy consumption and increase the use of renewable energy sources; its services are targeted to private households, local, regional and national authorities, businesses, and professional organizations, and include energy advise and auditing to households public-bodies and businesses, energy labeling for sustainable building programs, training, regional energy R&D programs, local energy strategies, third party financing programs, and European projects.

With reference to the "Products Production" goal, OEC-Cluster team efforts are directed at fostering innovation and competitiveness of OEC green-energy businesses. The actions of ESV Energy Agency towards OEC Cluster can be divided into the following major six fields (Table 4.1):

A cross-regional cluster initiative is related to the 37 companies from South-Bohemia. They are part of the OEC cluster and organized by and report to the ECCB (H) Energy Center in České Budějovice, South Bohemia. The ECCB is partner of O.Ö. Energiesparverband Energy Agency, Upper Austria and also receives funding from the Upper Austrian government. The Upper Austrian government/O.Ö. Energiesparverband Energy Agency have been supporting and

Table 4.1 Actions of ESV energy agency towards OEC cluster

Information and communication	Detailed cluster companies database; cluster web site; Frequent customer interviews; catalog of products and services; monthly newsletter and on-going information services to cluster members.
Training and Qualification	Analysis of educational requirements; activities for qualification of company staff; workshops, and seminars; study trips for employees; inter-company learning; co-operation with R&D and educational organizations.
Co-operations and Technology focus	Initiation and support of cooperation projects; establishment of contacts between potential project partners; co-operation with R&D, educational institutions and special service providers; set-up of special support programmes.
Research and development	The initiation and maintenance of research projects in the OEC partners, including with the support of the Energy Technology Program (ETP) of the province of Upper Austria and other support, are also among the fields of the OEC.
Marketing and PR	Information and Marketing material, National and international PR and advertising activities, Measures to strengthen the cluster image; trade fair company visits presentation for major customers; lobbying.
Internationalization	Access to international events, congress, topics, customers and trends; support of international cooperation; support companies during internationalization; attract foreign visits in the cluster; set-up activities among complementary international clusters.

Table 4.2 Ökoenergie-cluster; sales, employees, and export

	Y2003	Y2004	Y2005	Y2006	Y2007
Sales	0.22 bn €	0.29 bn €	0.39 bn €	0.51 bn €	0.62 bn €
Number of FTE employee	2,100	2,300	2,710	3,400	4,000
Export	>50%	>50%	>50%	>50%	>50%

has helped ECCB since its foundation. One of the tasks of ECCB is to arrange the exchange of technologies and know–how between Upper Austria and Southern Czech companies. Unfortunately it was not possible to obtain more detailed information regarding South Bohemian companies to understand their potential. The organizational structure strong point lies in the climate build with six major fields above that fosters co-operation and personal contact among company owners and managers, and sustain them with R&D, marketing and Internationalization activities.

Referring to the *Interactions between OEC-Cluster and Socio-Economical context*, the evolution dynamics of the OEC Cluster companies can be explained with the support of the following tables, derived from data stored in the V-LAB. Table 4.2 shows cluster data in terms of sales, number of FTE employees, and export. As it can be noticed, the cluster is under a strong growth trend with sales nearly tripled and employees nearly doubled during last 5 years. Although export information is a very good indicator to recognize cluster dynamics, unfortunately, it was not possible to obtain precise values, the indication obtained is that it has

always been more than 50%, with some medium sized companies export reaching 70–80%. Export countries are mostly EU 25 with 50% average export rate cluster companies not totally dependent on local market dynamics. This can be considered a strong point, 50% of export rate is indeed a good "stabilizer" of cluster dynamics versus regional and European policy changes.

The evolution and development of the OEC Cluster companies are strongly influenced by the demand of goods that comes for Interactions within the Socio Economical Context—ICSE.

In the sustainable-energy sector, the demand is driven by three factors:

- Legal measures: laws and regulations that can be strong/weak, long/short term policies to meet renewable energy targets.
- Financial aid measures: subsidies that are vital for the market growth.
- Information activities: development of public awareness is essential, if something isn't known about first, it will never be done.

These three factors lead to a change in the "inclination to spend", of consumers when the consumers recognize a return on the investment for the new "eco-installation" from a payback/return on investment model that includes: eco-installation costs, subsidies, energy consumption, energy produced savings, future "traditional energy" cost increase, and interest rates.

The cluster dynamics are strongly dependent on regional or European laws, and policies; in fact, depending on how laws are used, these can be a "turbocharger" for the sector at the point of having it grown too fast or on the opposite side, when incentives are reduced, laws can also risk to "kill the renewable energy industry". Investments besides R&D are directed at start-up companies and to increase the production capacity of current companies, building larger plants.

Appendix: V-LAB of Ökoenergie-Cluster

See Figs. 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.10

(A) DESNET (DEmand & Supply NETwork) Identification	
Name	Ökoenergie-Cluster Upper Austria (Sustainable Energy-Cluster Upper Austria)
Address	Landstraße 45, 4020 Linz, Austria
Web site	
E - mail	

Fig. 4.3 Heading space of the V-LAB format

Identification

Keywords – issues *please indicate*			
English			***National language (Italian)***
product	software & application		software & applicazioni
	Information & description		informazioni & descrizioni
	method	X	metodi
Sector	automotive		automobilistico
	money & right		banche & finanza
	chemistry		chimico
	advertisement & media		media & pubblicità
	nature & environment	X	Natura & ambiente
	architecture	X	archietettura
	biology		biologia
	electronic & computer	X	elettronica & computer
	mechanical engineering	X	meccanico
	education & science	X	scienza & educazione
	authorities & federations		istituzioni & federazioni
	aerospace		aerospazio
Terms of process	engineering	X	costruzioni/ingegneria
	manufacturing	X	manifatturiero
	Research & development	X	ricerca&Sviluppo
	service	X	servizi
	marketing	X	marketing
	production	X	produzione
	design	X	design
	controlling		revisione & controllo
	cooperation		cooperazione
	communication		comunicazione
	coordination		coordinamento

Fig. 4.4 V-LAB keywords—issues to specify the network's industrial sector

Links to the Main CODESNET Issues			
Operation Structure	distribution of production operations & volumes		Distribuzione delle attività di produzione e volumi
	employment of different skills	X	Utilizzo di competenze diverse
	optimizing of logistic transport capacities over internal links		Ottimizzazione delle capacità logistiche e di trasporto su collegamenti interni
Organization Arrangement	communication of management responsibilities and information		Comunicazione e informazione sulle responsabilità di gestione
	negotiation of internal agreements/ control mechanisms, or agreements with external bodies		Negoziazione di accordi interni/ meccanismi di controllo o accordi con enti esterni
	selecting of assure best efficiency/ effectiveness of organization chart or coordination strategy	X	Efficacia della struttura organizzativa o delle strategie di coordinamento
Interactions with Socio-Economic Environment	negotiation of commercial agreements with client/supplier for max profit for the network		Negoziazione di accordi commerciali con clienti/fornitori per max i profitti della rete
	deciding of a network innovation program by the partners and negotiated with financiers	X	Definizione di programmi di innovazione di rete e loro negoziazione con finanziatori
	forecasting of dynamic evolution of a network	X	Previsione di evoluzione dinamica di una rete
Short description of the industrial DESNET and of its product and/or services	The "Oekoenergie-Cluster" OEC, in the Upper Austria region, is the network of companies and organisations producing renewable energy and energy efficiency technologies or providing related services. 146 companies and organisations as well as 37 companies from South Bohemia have joined the OEC partnership (as of February '08).		Il distretto "Oekoenergie-Cluster" OEC (eco-energia) nell'Austria superiore, è la rete di imprese e di organizzazioni produttrici di sistemi per le energie rinnovabili, efficienza energetica o fornitori di servizi diretti a questo settore. 146 aziende ed organizzazioni dall'Austria superiore e 37 aziende dalla Boemia del sud fanno parte del distretto OEC (Febbraio '08).

Fig. 4.5 Main CODESNET issues characterizing the network presented in the V-LAB

Links		
	English	*National language*
Strong Points explained	1. Operation structure 2. Organization structure 3. Interaction with socio-economic environment	1. Struttura operativa 2. Assetto organizzativo 3. Interazioni con il contesto socio-economico
Further information	The Oekoenergie-Cluster was founded in 2000 with the aim to foster innovation and competitiveness of green energy businesses in Upper Austria and to contribute to a positive market trend in the field of sustainable energy production and use. The energy sector in Upper Austria transformed itself from a group of traditional companies and farmers owning heating districts to an environmentally innovative cluster that is having a great impact on energy innovations beyond regional borders and is being one of the European leaders in the green energy field. This region was able to understand the importance of environmental businesses and take proper actions to successfully put together actors that were not used to work together, even though part of the same value chain. Nowadays, the global demand for reduced CO_2 emissions and increasing oil prices has become the main driver for the growth of this sector.	

Fig. 4.6 Strongest points of the network presented in the V-LAB

Network Overview	
General Information – Qualitative Information	
Network type	Network of businesses that covers the whole field of eco-energy from the production of renewable energy technologies to the installation, consumption (energy efficiency), and related services from the sectors of: - Solar energy (solar thermal, photovoltaic) - Biomass and biogas - Wind energy - Geothermal energy and heat pumps - Small hydro power - Low energy buildings - Energy performance contracting - Energy efficient lighting - Energy advice - Energy efficient building services
Distribution on the region	The 145 companies and organisations are located in the Upper Austria, which is a highly industrialised region in the Northern part of Austria and 35 companies from South Bohemia Region which is an administrative unit of the Czech Republic.
Personnel / skills	Although the level of education and training is quite high (personnel with university education as well as highly qualified technicians) the fast growing cluster companies are still encountering problems in finding specialized workers since with fast changing and innovative technologies the work force needs to build new skills. This problem has led to the creation of an applied university degree on the matter to respond to the cluster's needs. Competence building trainings have also been launched by the cluster association to develop people competencies with environmental technologies.
Coverage of product market	The Upper Austrian eco-energy cluster benefits from a sophisticated local demand, reached thanks to the regulation and by the improved offer due to the fierce competition. More than 30 % of Upper Austria primary energy consumptions are produced from renewable energy sources (approx. 15 % hydro energy, 13 % biomass, 2 % solar energy). The biggest customers of the cluster companies are on the private sector (homes, domestic market share), as it has benefited from financial support already since the 1980s. The industrial segment, and the number of companies serving it, is increasing, whereas the public market, enforced by regulation, in comparison with the previous is rather small. The export share of the cluster companies is over 50% with European countries as main export destinations.

Fig. 4.7 V-LAB network overview (continued)

Performance Indicators – Quantitative Information

Estimated annual sales

Y2003	Y2004	Y2005	Y2006	Y2007
~0.22 bn €	~0.29 bn €	~0.39 bn €	~0.51 bn €	0.62 bn €

(Note: historical data obtained from Clusterland OO GmbH www.clusterland.at reports and slides)

Area description

Upper Austria is a highly industrialised region in the Northern part of Austria with the Czech Republic to the north and Germany (Bavaria) to the west. Upper Austria is located in the heart of Europe along the European west-east axis (Paris-Budapest) and north-south axis (Malmo-Trieste). The GDP per capita in the region is 103% (well above EU level), the industrial sector (steel making, chemicals, mechanical engineering, automotive products and general metal working) provides more then 50% of upper Austria production value and employs 60% of the regions industrial labour while agriculture sector employs 13% of region labour force.

Population	1.4 Million inhabitants - 17.1% of the Austrian population
Economy	68,626 commercial companies 576,203 employees 32,6 € bn gross domestic product 24.9 % of Austrian production value 3.7 % economic growth 26.5 % of Austrian export 3.6 % unemployment rate
Administrative structure	18 political districts 445 municipalities 3 statutory cities (Linz, Steyr, Wels)
Area	12,000 km² - 14.3% of the national territory - fourth largest federal state
Rivers	Donau, Inn, Enns, Traun, Steyr

Sources: Statistics Land Oberösterreich, 2006
Hauptverband der Sozialversicherungsträger
Wirtschaftskammer Oberösterreich 2007

Average employee numbers in Upper Austria 2005:

	Total	Men	Women
Total employees	571,500	316,633	254,867
Blue-collar	248,388	173,433	74,955
White-collar	283,511	117,306	166,205
Civil servants	39,601	25,894	13,707

Fig. 4.7 (continued)

Average firm dimension

The Upper Austrian eco-energy cluster is NOT formed by some big leaders surrounded by SME's depending on them. Competition between companies is strong, and this has been one of the major factors for success.

Type of enterprise, company or institution	Definition of enterprise category		Number of companies / organisations
	Employees (headcount)	Annual turnover (million €)	
Large Enterprise	> 250	> 50	13
Medium Enterprise	50 – 250	10 – 50	19
Small enterprise	10 – 49	2 – 10	37
Micro enterprise	< 10	< 2	64
Research Institutions (Universities, Polytechnics)			8
Services (Trade Associations, etc.)			1
Administration (concerning energy)			
TOTAL			142

Source: Competitiveness - Eco-energy clustering efforts in Upper Austria

Many of the current cluster association member companies have grown from small craft businesses to internationally operating enterprises. Several of them have begun European market leaders in their respective fields, especially in small-scale biomass boilers.

Number of employees (full time equivalent)				
Y2003	Y2004	Y2005	Y2006	Y2007
~ 2,100	~ 2,300	~ 2,710	~ 3,400	4,000

(Note: historical data on employee is obtained from Clusterland OÖ GmbH www.clusterland.at reports and slides)

Export volumes (annual) of the DESNET

Export share is high and as an average over 50% with some medium size companies ranging from 70% to 80%.
Export countries: D, I, F, E, GB, IRL, B, NL, L, CH, S, N, CZ, SLO, PL, HU, RO, CA, USA, NZ.

Fig. 4.7 (continued)

Operation Structure	
Qualitative Information	
Division of labour among firms	The OEC cluster companies and organisations work in the following fields: Biomass, Energy efficiency and advise, Geothermal energy, Heat pumps, Photovoltaic, Small hydropower, Solar-thermal energy, Wind energy. Companies and organizations within the cluster are spread as: ~ 40% are producers of equipment (components and final products), ~ 40% are active in planning, distribution or consulting, installation. ~ 20% are organisations and institutions in R&D, training and other related fields. In the cluster there are no big leading companies but high competition among companies.
Organization of logistics and distribution	Logistic is organized by external companies. The OEC eco-energy cluster companies as well as all Upper Austrian clusters (www.clusterland.at) are supported by an inter-branch logistic network (www.vnl.at) with the aim of strengthening logistic competences in a sustainable way and increase logistic know-how and competences.
Performance Indicators – Quantitative Information	
Degree of concentration of production	~ 1.9 % (0.62 bn € cluster sales vs. 32,6 € bn regional gross domestic product)
Logistic bodies; carriers; personnel	N/A
Applied ICT technologies	ICT technologies are very strong in the region.

Fig. 4.8 Operation Structure (OS) data of the network presented in the V-LAB

Organization Structure	
Qualitative Information	
Agreements and control mechanisms among partners	The OEC cluster is managed by the O.Ö. Energiesparverband, the Energy Agency of Upper Austria, that was founded in 1991 and is financially supported by the Regional Government/Department of Economics of Upper Austria. The Energy agency reports annually to the Regional Upper Austrian Government and the outcome of activities is integrated in the strategies for following year reinforcing the weakest areas within the regional energy action plan, and determining clear goals as well as numerous implementation measures. The O.Ö. Energiesparverband supports the market development of sustainable energy production and use through programs and projects.
Responsibilities in the network	The management scheme followed for OEC cluster is summarized in the "Cluster Management Guide – Guidelines for the development and Management of Cluster Initiatives" www.clusterforum.org One of success factor is that the management concept of OEC cluster is strongly focused on having personal contacts and exchange of views with owners and managers of cluster companies. The management efforts of OEC cluster team are focused in fostering strong co-operation among cluster partners supported by good information and communication systems. Co-operation among cluster partners includes the participation in projects among companies, universities and R&D institutions. Focus is also placed by OEC team in visiting the cluster companies, at least once a year. The numbers of organized events, co-operation projects and company visits within the cluster are monitored yearly as key indicators.
Existence of collective agreement with external bodies	Inter-branch networks have been developed in Upper Austria in the areas of Human resources, Design & Media, Environmental technology and Logistics, mainly focused on the needs of SMEs in strengthening their competencies in inter-branch know-how transfer and innovation. Ref. scheme below from "Clusterland Upper Austria" www.clusterland.at.

Fig. 4.9 Organization Arrangement (OA) data of the network presented in the V-LAB (continued)

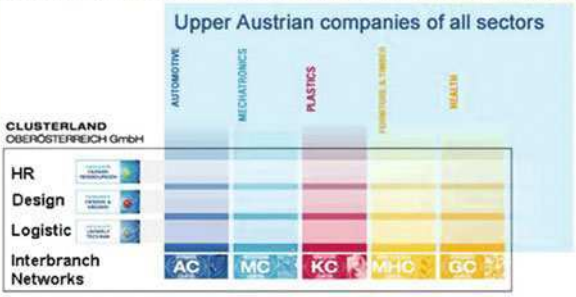
Existence of collective agreement with external bodies	Inter-branch networks have been developed in Upper Austria in the areas of Human resources, Design & Media, Environmental technology and Logistics, mainly focused on the needs of SMEs in strengthening their competencies in inter-branch know-how transfer and innovation. Ref. scheme below from "Clusterland Upper Austria" www.clusterland.at. 
Existence of larger leading firms in the DESNET	None.
Performance Indicators – Quantitative Information	
Type of coordination body & function	The cluster coordinator is "O.Ö. Energiesparverband", the Regional Energy Agency. It is organized as a non-profit association with 31 members including energy suppliers, energy consultancies, environmental groups, professional associations and firms involved in energy technology and the Upper Austrian government.
Type of organization structure	Functional.
Number of leading firms; average size of leading and ancillary firms	No leading firm (ref. table from "Average firm dimension" section).

Fig. 4.9 (continued)

Interaction with Socio-Economic Environment	
Qualitative Information	
Marketing strategies	The OEC cluster actions towards the development of local and European markets include initiatives focused in "creating demand" and in "meeting demand" supported by following activities: ➢ Information and communication: developing and up-dating a company data base, the OEC website www.oec.at; an English/German catalogue of products and services; and on-going information services for its members. ➢ Training: organizing training courses, business events and workshops on sector specific topics. ➢ Co-operation & technology focus areas: launching, developing and supporting co-operation projects between OEC partners and with technology transfer facilities (such as universities or research institutes), cooperating with other networks and "clusters". ➢ Research and development: launching, developing and supporting research projects of OEC partners, for example supported by the "Energie-Technologie-Programm ETP" (the Upper Austrian Energy Technology R & D Program). ➢ Export: representing the OEC internationally, supporting export activities of the cluster partners in co-operation with the Chamber of Commerce, networking with energy agencies from other countries. ➢ Marketing and Public Relations: compiling information material on green energy topics, promoting the OEC in Austria and abroad, implementing PR, market research and market development projects.
Degree of integration of the DESNET with its local labour market	Local labour market is regulated by Austrian policy which is characterized by intensive interaction between governmental and other institutions. Social partners participate in the development and implementation of laws and policy measures on a number of committees. A series of laws are in place to regulate labour market regarding: illegal employment, quotas for foreign workers, unemployment benefits and assistance, pension advance transition into retirement and temporary employment. Labour costs in industries and construction averaged €28.09 per hour actually worked in 2006.
Performance Indicators – Quantitative Information	
% employees in DESNET firms over the population	~ 0.7 % (4,000 DESNET employees vs. 571,500 ready to work people).
Number of DESNET firms over number of firms in the area	~ 0.2 % (145 DESNET firms vs. 68,600 firms in the area).
Note	

Fig. 4.10 Data concerning the interaction with socio-economic environment (ISEE) of the V-LAB represented network

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Chapter 5
Supply Network Structures and SMEs: Evidence from the International Clothing Industry

B. L. MacCarthy and P. G. S. A. Jayarathne

Abstract Many different types of supply networks have been discussed in the literature. However, their relevance for SMEs has not been discussed in detail. This chapter briefly reviews supply network typologies and their relevance for SMEs. Analysis is presented of supply networks in the international clothing industry that has emerged over the last three decades to supply garments to global markets. Such networks include highly powerful entities such as major retailers as well as many smaller players. They operate with different structures and different operational strategies, and practices. The chapter considers the operation of these networks and their implication for SMEs. Sri Lankan clothing manufacturers operating within retail-driven international supply networks are described. The role of SMEs and how they collaborate with larger players in these dynamic networks are discussed. The chapter concludes with policy implications for government authorities and the business community. Important research directions are highlighted for the academic community.

5.1 Introduction

The structure, operation, and governance of supply networks have received considerable attention from both the business community and academic researchers in recent years. Interest has increased as globalization has accelerated and added to the complexity, and dynamics of supply networks.

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The clothing industry is one of the most mobile and dynamic industries in the world (Martin 2007). Over the last three decades, complex international supply networks have emerged to supply garments to global markets. These internationally dispersed networks may operate with different structures and different operational strategies and practices. They include highly powerful entities such as major retailers as well as many smaller players. Here we consider international clothing supply networks from the perspective of small and medium-sized enterprises (SMEs). Although many different types of supply networks have been discussed in the literature, their relevance for SMEs has not been discussed in detail. The aim of this chapter is to consider operational strategies and practices in supply networks in the international clothing industry with regard to their implication for SMEs.

In this chapter supply network types discussed in the literature are reviewed briefly and their relevance for SMEs is noted. The nature of international clothing supply networks is discussed. The chapter then describes how small and medium-sized Sri Lankan clothing manufacturers operate in different types of networks. The chapter concludes with policy implications for government authorities, the business community, and the academic research community.

5.2 Supply Networks and SMEs

Different definitions have been given for the term 'supply network' (e.g. Harland 1996; Harland and Knight 2001; Harland et al. 2004; Christopher 2005). The definition given by Harland and Knight (2001) is used here. They define a supply network as comprising of actors, resources and activities, and their connections relating to transforming inputs into products and services. They indicate that supply network structures relate to the way actors, resources, activities, and their connections are organized to transform inputs into products and services.

Supply network research can be classified broadly as falling into two schools of thought (Lamming et al. 2000; Harland and Knight 2001), namely operations strategy and supply strategy. Across these two disciplines, supply networks have been studied from different perspectives, e.g. network structure perspectives (Cravens et al. 1996; Ernst and Kamrad 2000; Garavelli 2003; Holweg et al. 2005; Cheng and Kam 2008), as well as power and governance perspectives (Cox et al. 2001; Verwaal and Hesselmans 2004; Provan and Kenis 2007). Here we review some of the supply network types that have been proposed with respect to their consideration of, and implications for SMEs. Some of these network typologies fail to provide specific insights relevant to SMEs but some do so explicitly or implicitly.

Hinterhuber and Levin (1994) identified four types of networks—internal networks (SBU), vertical networks, horizontal and diagonal networks. As they note, there are implications for SMEs in all these types of networks. All appear in industrial clusters, which typically emerge from groupings of SMEs. Further, they

describe how these different networks tend to evolve in a sequence in industrial clusters, citing examples in optical frames (Italy), decorative ceramics (Germany) and an example of a clothing firm. In the case of the clothing industry, they describe Benetton as having a vertical network structure as it uses franchising when dealing with retail partners, while using sub-contracting (mostly to SMEs) to work with suppliers.

Grandori and Sodas (1995) discuss three main types of supply networks—social networks, bureaucratic networks, and proprietary networks. Within these main types, two further dimensions are highlighted—whether formalized or not and whether centralized or parity-based. Accordingly, within the 'social networks', personal networks, interlocking directorates, and some forms of industrial districts are noted as symmetric or parity-based in which there is no central control. Putting-out, constellation, and sub-contracting are noted as asymmetric or centralized networks, which have a central control by a focal company. Trade associations and consortia are noted as symmetric bureaucratic networks whereas agency networks, licensing and franchising are noted as the most important asymmetric forms of bureaucratic networks. Joint ventures and capital ventures are noted as the main types of proprietary networks.

Grandori and Sodas (1995) do note that there are implications for SMEs in social networks, particularly in industrial districts and in sub-contracting. Further, it is implied that SMEs may operate in bureaucratic and proprietary networks especially when they collaborate with large companies via franchising and joint ventures. However, such implications have not been discussed in detail.

Robertson and Langlois (1995) categorize supply networks into six cluster types, namely holding companies, marshallian districts, venture capital networks, Japanese Kaisha networks, Chandlerian firms, and 'third Italian districts'. They note explicitly that SMEs operate in Marshallian districts and in 'third Italian districts' as these two types of network clusters help small and medium-sized firms to survive. Also, SMEs supply components for Japanese Kaisha networks, for instance in Toyota's networks.

Cravens et al. (1996) describe four types of networks—flexible networks, hollow networks, virtual networks, and value-added networks. Although SMEs are not mentioned explicitly, firms in flexible networks utilize the competency of SMEs using various forms of inter-organizational cooperation and partnership, including the development of formal alliances and joint ventures to meet requirements in the highly volatile markets. Further, there is room for SMEs to operate in value-added networks in which focal companies contract production globally, while retaining innovation and product design internally. Moreover, firms in virtual networks may create and maintain collaborative relationship with SMEs in order to fulfil demand in environments with relatively low volatility.

Rosenfeld (1996) use the object of exchange as the basis for classification and identify two types of networks—hard and soft. These two types commonly apply in any industry as they are mostly general clusters. Therefore, it is clear that there are implications for SMEs in both these types of networks although it has not been noted explicitly.

Nassimbeni (1998) identifies three main supply network categories—'supply network', 'agreements and joint ventures', and 'regional industrial systems'. Within the 'supply network' two sub-networks are noted—'main contractor and sub contractors' and 'production chains'. In practice, SMEs operate in regional industrial systems and implicitly SMEs also operate in the 'main contractor and sub-contractors' and in 'production chains'. Moreover, 'agreements and joint ventures' also involve SMEs when they collaborate with large companies in order to gain benefits that are harder to achieve individually.

Lamming et al. (2000) discuss four types of supply networks—high complexity networks producing innovative-unique products, low complexity networks producing innovative-unique products, high complexity networks producing functional products, and low complexity networks producing functional products. SMEs may operate in all four types supplying functional products as well as innovative products, regardless of their complexity.

Ernst and Kamrad (2000) identify four types of supply networks—rigid networks (i.e. vertically integrated networks), flexible networks that use many sub-contractors to produce components, modularized networks that have multiple sources for components and the output is the finished product, and postponed networks that aim to exploit economies of scale in the making of components while customizing the finished product. Even though they have not explicitly discussed the operation of SMEs in these types of network, they note that sub-contractors supplying components are mostly SMEs. Flexible networks require the service of SMEs operating as sub-contractors. Furthermore, there may be implications for SMEs in both, modularized and postponed structures, in supplying components for the assembly processes.

Harland et al. (2001) describe four types of supply network based on the level of influence of the focal firm—dynamic/low degree of focal firm influence, dynamic/high degree of focal firm influence supply networks, routinized/low degree of focal firm influence, and routinized/high degree of focal firm. Although the implications for SMEs have not been discussed in detail, an example they note—minor suppliers in the process or textile industries—highlights that SMEs operate in 'routinized/low degree of focal firm influence' networks. Furthermore, SME participation in 'routinized/high degree of focal firm influence' networks is implied with examples from automotive assembly, in particular Toyota. It is known that the Toyota network consists of a large number of SMEs producing components for assembly.

Lee (2002) classifies supply networks into four based on demand uncertainty and supply uncertainty—efficient supply chains, risk-hedging supply chains, responsive supply chains, and agile supply chains. Although the implications for SMEs are not discussed explicitly, the examples given show that SMEs may operate in efficient supply chains, which supply functional products under stable processes, and risk-hedging supply chains, which supply functional products under evolving processes and arguments may be made for SME participation in other identified classes.

Garavelli (2003) has presented different network configurations relevant to manufacturing and logistics flexibility. Three configurations are discussed—networks with no flexibility, limited flexibility, and total flexibility. The implications for SMEs are not discussed explicitly, but the link between SME participation in networks and flexibility, is an interesting one deserving more research attention.

Verwaal and Hesselmas (2004) identify four types of supply networks—equal-partner networks, dominated networks, market exchange, and vertical integration. Although not explicitly discussed, powerful players in dominated networks may utilize the service of SMEs in many sectors. The link between SME participation and power dominance in networks is an important research theme that needs further exploration.

Holweg et al. (2005) notes four types of supply chain configuration—traditional, information exchange, vendor-managed replenishment, and synchronized supply chains. The implications of SMEs are not explicitly noted. However, there is potential to explore the implications for SMEs further, across all of these configurations.

Provan and Kenis (2007) identified three types of supply network—participant governed networks, lead organization governed networks, and network administrative organizations. Although there are implications for SMEs in these networks, they are not discussed explicitly or implicitly. Clearly the governance structure and governance processes in a network, either formal or informal, are important issues for SMEs and merit further examination by the research community.

A number of other typologies and classifications have been published (e.g. Achrol and Kotler 1999; Cox et al. 2001; Cheng and Kam 2008) but their implications for SMEs have not been explored explicitly or implicitly.

As is evident form the above discussion, most studies on supply network structures have not addressed explicitly the participation, roles or operation of SMEs in supply networks. This is not surprising as these studies were not specifically SME-focused. A number of studies have identified the participation of SMEs as sub-contractors. However, the nature of the SME sub-contractors' roles in network structures has been debated. The brief review of the literature above has identified a number of other areas where detailed research is required with regard to the relationships between SMEs and supply networks, e.g. the relationships between network structure, governance, and power. Here we look in detail at strategy and practice in international clothing supply networks that incorporate SMEs.

5.3 International Clothing Supply Networks

Apparel supply networks may contain many entities including designers, merchandisers, yarn producers, fabric producers, trims producers, garment manufacturers, distributors, logistics and warehouse companies, and retailers (Wadhwa et al. 2008). Retailers and major brand owners tend to be the most powerful players

in such networks (Gereffi 1999; Tyler et al. 2006; MacCarthy and Jayarathne 2010b).

Many of the major retailers and brand owners are based in the US and the EU, which are also major clothing markets. A number of factors have influenced retailers and brand owners in deciding to source internationally—market trends, raw material and capacity availability, cost advantages, and other factors such as trade policies, in particular deregulation following the Multi-Fibre Agreement at the end of 2004 (UNCTAD (2005). With these trends, apparel manufacturing has migrated across the newly industrialized countries, developing countries, and under-developed countries in the last two decades (UNCTAD 2005). Consequently clothing supply networks have become not only internationally dispersed but also long, complex, and heterogeneous.

Figure 5.1 illustrates an international clothing supply network in generic form, described in detail by MacCarthy and Jayarathne (2010a). The upstream textile producers supply the clothing manufacturing plants, which in turn feed into logistic systems to deliver into specific retail chains and ultimately to specific stores in order to meet forecasted demand. The solid line crossing the Regional Distribution Network (RDC) highlights conceptually the balance of global and local practices. A major supplier may have to manage the interface between its distribution system and that of each of the retailers or brand owners, it supplies (MacCarthy and Jayarathne 2010a). Much of the material flow complexity occurs around manufacturing plants and in the logistics systems. Fig. 5.1 is limited in displaying the interactions of the diverse sets of entities that operate within the network including designers, buyers and merchandisers, distributors, logistic and warehouse companies, and service providers for clothing embellishments (e.g. such as embroidery).

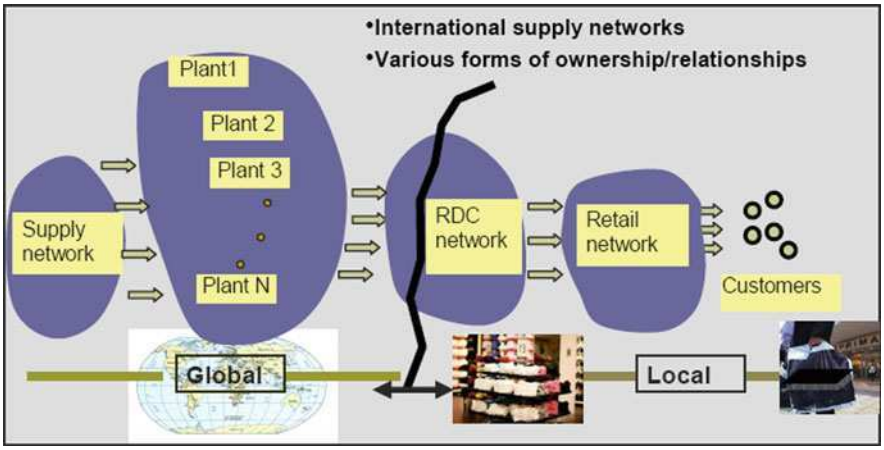

Fig. 5.1 A generic international clothing supply network
Source MacCarthy and Jayarathne 2010a

A number of factors have influenced the changing dynamics of these global supply networks. In addition to changes in international trade policies, the emphasis on compressing new product introduction time, multiple refreshes per season, and very quick response from the suppliers' side at low or reasonable cost (Tokatli 2007; Sen 2008; MacCarthy and Jayarathne 2010a) have accelerated the mobility of these networks.

Some countries have benefited from this mobility whilst others have lost out. In particular, China and India have shown very strong growth after 2004 (Audet 2007). However, a country like Sri Lanka with a long tradition of apparel manufacturing has been seeing its clothing industry decline from 71% of its total industrial exports in 2004 to 59% in 2008 (CBARSL 2009).

The high mobility of apparel networks has specific relevance for SMEs. The majority of the major apparel producing nations are developing countries—China, India, Indonesia, Bangladesh, and Pakistan (Audet 2007). Large apparel manufacturers based in these countries make extensive use of SMEs. Understanding how SMEs in developing countries can operate successfully in the international clothing supply networks, is therefore important. Sri Lanka provides a case in point.

The Sri Lankan clothing industry has evolved over the last three decades and is currently the most important industrial sector in the economy in terms of production, employment, and foreign income source (CBARSL 2009). Approximately 40–45% of the industrial production comes from this sector (CBARSL 2009). The industry provides about 330,000 direct employment opportunities for the nation (CBARSL 2007). Moreover, this sector is the largest single foreign income generator for the country (CBARSL 2009).

However, with the abolition of the MFA in 2005, Sri Lanka faced high competition in the global market. The number of manufacturers reduced from 891 in 1999 to 830 in 2005 (CBARSL 2006). However, in 2008 only 300 manufacturers—large, medium, and small firms—remained (Wijayasiri and Dissanayaka 2008). Table 5.1 shows that a large proportion of apparel manufacturers—72%—are SMEs. The threat of closure is greatest for SMEs unable to cope with the rapidly changing market requirements (CBALSL 2009). This emphasizes the need for SMEs to engage in, and be part of effective networks and clusters. Most Sri Lankan SMEs operate in collaboration with large apparel manufacturers' networks, which either directly or indirectly work with powerful retailers in the global market. The Sri Lankan government has identified SME apparel manufacturers as requiring special attention and a number of programmes have been implemented for their survival (CBARSL 2009).

Table 5.1 Classification of Sri Lankan apparel manufacturers

Categories	Basis for categorization—employees	Percentage
Small	1–100	19
Medium	101–500	53
Large	Over 501	28

Source CBARSL 2006

5.4 Empirical Evidence on International Clothing Supply Networks and SMEs

MacCarthy and Jayarathne (2010b) identify 24 types of supply networks in which Sri Lankan apparel manufacturers—both large companies and SMEs—operate, based on the empirical evidence from 30 apparel manufacturers. These networks supply both simple and more detailed fashionable garments for leading retailers (e.g. M&S, Next, Victoria Secret, etc.), as well as supermarket brands (e.g. Asda, Tesco, Sainsbury, etc.).

Not surprisingly, SMEs operate mostly as sub-contractors in collaboration with larger companies but in different ways in different types of networks. Three case companies are used to illustrate different relationships. The case companies are of different size—a large-scale manufacturer, a medium-scale manufacturer, and small-scale manufacturer. These case companies operate in different supply networks identified by MacCarthy and Jayarathne (2010b). The precise company identities are protected.

Case 1—a large apparel manufacturer—shows how SMEs participate as sub-contractors in the supply network of a large apparel manufacturer. The material and information flows, as well as quality processes for the whole company are explained and the operations of SMEs in the network are highlighted. Case 2—a medium-scale manufacturer—shows how material and information flows, and quality processes change when the company operates as a sub-contractor to a large manufacturer. Case 3 illustrates material flows, information flows and quality processes for a small-scale manufacturer operating solely as a sub-contractor in the apparel network.

5.4.1 Case Company 1 *A Large Manufacturer*

Company SLH is a leading established Sri Lankan apparel company and a major supplier to a range of well known retailers, garment brand owners and supermarkets including M&S, Tommy Hilfiger, Liz Claiborne, Nike, Victoria's Secret, Polo, Bhs, Tesco, and Asda. Currently it operates with an integrated manufacturing structure that includes designing processes, product development, factories, printing, embroidery, and washing facilities. Figure 5.2 illustrates material and information flows, as well as quality processes for the whole of Company SLH, encompassing all of the prime customers it serves.

As Fig. 5.2 depicts, different retailers place orders with the company either directly or through agents. Such orders are distributed among the production clusters as per the retailers' request, considering the competency of each cluster. Further, certain orders are fulfilled with the support of sub-contractors (the detailed description is given below). Then, fabric and accessory sourcing is carried out either by the respective cluster or according to the agent's recommendation. These

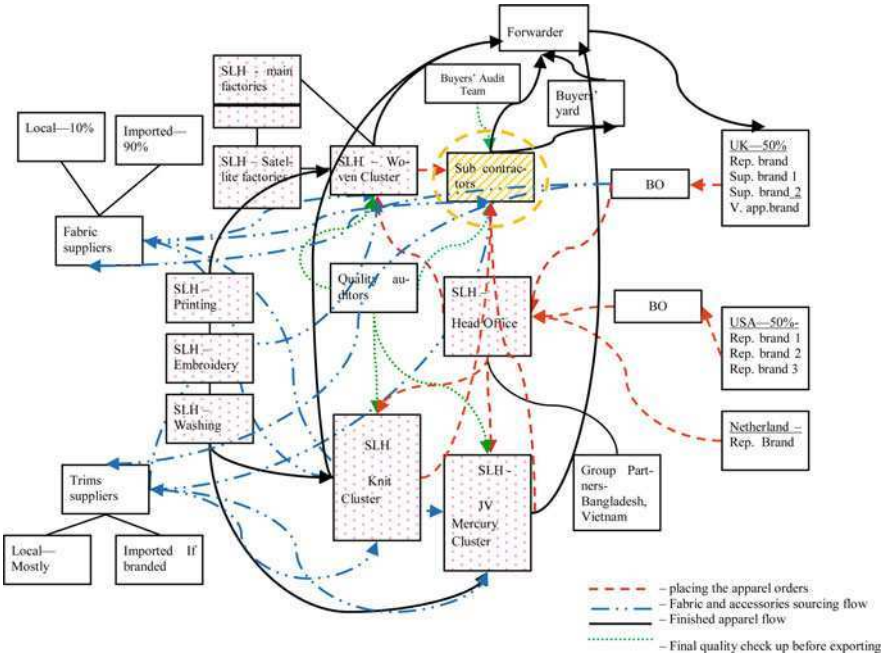

Fig. 5.2 Overall supply network of company SLH. *Dot-shaded area* represents the prime company (SLH) and *line-shaded area* represents the sub-contractors. *BO* Buying Office; *Rep. brand* Reputable brand; *Sup. Brand* Supermarket brand; *V.app brand* Value apparel brand

raw materials are sourced both locally and internationally, and sent directly to the relevant cluster. After finishing the production process, final audit is conducted either by the company itself or by the team appointed by the retailer's agent. Then, the final garments are sent to the relevant retailers through forwarding companies nominated by the respective retailers.

The operational practices of the company when dealing with sub-contractors—SMEs—are different from their usual practices noted above. The sub-contractors, in particular SMEs are selected by the buyers' audit team: an external party appointed by the respective retailers. Then, once the orders are received from the retailers, a certain amount of orders are assigned to those selected SMEs that have been agreed by the retailers.

Initial sample development is generally not carried out by SMEs. Further, these SMEs are not involved in sourcing; instead all raw materials such as fabrics and accessories are supplied by the prime company (SLH) along with the orders. Further, SLH closely monitors the production plan of such SMEs to ensure that orders are being produced according to the action plan prepared by the company at the planning stage of apparel production. This is done to meet the delivery dates agreed with the retailers. Meeting the delivery dates and production quantities are the responsibility of SLH regardless of who produces the garments. Further, SLH

is very closely involved in the quality assurance procedure of the SMEs to ensure that garments are produced as per the quality requirements set by the retailers. All the raw materials are checked for quality at the prime company before being sent to SMEs. The quality team of the main company visits these SMEs regularly and is involved in both in-line and end-line quality checking along with the quality assurance staff of the respective SMEs. Final quality checking, known as acceptable quality level (AQL), is also done by the respective quality staff of the prime company before authorizing the finished garments for forwarding to the customer's warehouses. Once final approval is given, the garments that are initially sent to the warehouse of the retailers based in Sri Lanka are then exported to the respective retail stores through forwarding companies nominated by the retailer. In certain cases, after the final approval is given they are handed over directly to forwarding companies for exporting purpose.

5.4.2 Case Company 2 *A Medium-Scale Manufacturer*

Company SLT is a medium-scale apparel manufacturer supplying menswear, ladies' wear, children's wear and baby wear to Europe and USA. Customers include major retailers, brand owners, and branded retailers. SLT operates either as a main producer or as a sub-contractor to another main producer for these retail brands.

Figure 5.3 shows orders are placed by different retailers either directly or through agents. Further, this company operates as a sub-contractor for another company. Orders taken from retailers—either directly or indirectly—are distributed among the production plants according to retailers' requests. Then, fabric and accessory sourcing is carried out either by the respective agent or by SLT in collaboration with agents. These raw materials are sourced both locally and internationally, and sent directly to the relevant production plants. After finishing the production process, the final quality audit is mostly conducted by SLT itself. Then, the final garments are sent to the relevant retailers through forwarding companies nominated by the respective retailers.

The operational strategies of this company as a sub-contractor are different from their usual practices noted above. It is important to note that this company can also be considered as an SME in sub-contracting relationships. In this case, a large apparel manufacturer (main company) gives orders and subsequently assigns them to the manufacturing plants according to the request of the main company. In fact, only limited manufacturing plants are assigned for sub-contracting orders. Further, all raw materials—fabrics and accessories—are sourced by the main company and delivered to the respective production plants. Then, the production process is closely monitored by the main company while paying high attention to the production plan that it has created. Further, quality assurance process for sub-contracting orders is also done with the close involvement of the staff at the main company. The initial stage of the quality assurance process—raw material

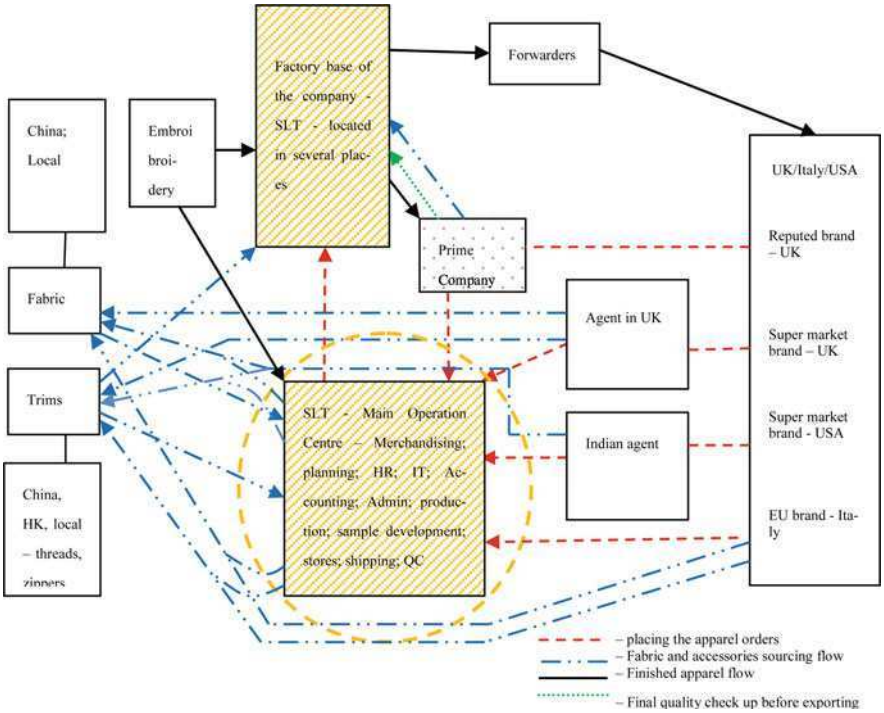

Fig. 5.3 Overall supply network of company SLT. *Dot-shaded area* represents the prime company and *line-shaded area* represents the sub-contractor (SLT)

checking—is carried out at the main company. Then, quality assurance staff of the main company regularly seeks to ensure the quality of garments throughout the production process. Further, the final quality inspection (AQL) is also carried out by such staff at the main company. Accepted orders are sent to the forwarding company for exporting purpose.

5.4.3 Case Company 3 *A Small Apparel Manufacturer*

Company SLT is a small apparel manufacturer producing garments for leading brands solely through large manufacturers. Although this company has expertise in both knitted and woven apparel, it mostly produces knitted garments for both the US and the EU markets.

Figure 5.4 shows the material and information flows as well as quality assurance process for the company SLC by looking at the network from the lens of SME. Accordingly, orders are received from different retailers only through large apparel manufacturers (prime companies). In other words, this company engages solely in sub-contracting. Orders mostly come through retailers' agents. Fabric and

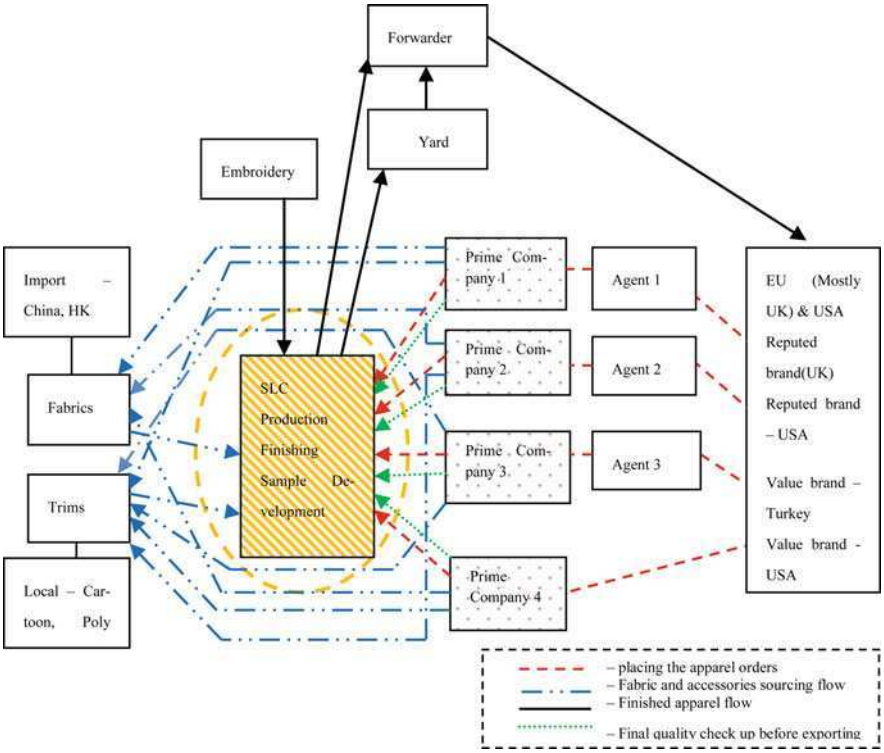

Fig. 5.4 Overall supply network of company SLC. *Dot-shaded area* represents the prime company and *line-shaded area* represents the sub-contractor (SLC)

accessory sourcing is carried out by the respective prime companies according to the recommendations of agents. As all orders are received from prime companies, they are closely involved in production planning as well as quality assurance process in order to ensure that their garments are produced to approved quality standards and meet the targeted delivery dates. In fact, the quality staff of prime companies set the quality standards, conducts the initial quality checking for raw materials, and are involved in in-line and end-line quality checking, as well as carrying out the AQL. Once approval is given, finished garments are sometimes sent initially to the retailers' depot in Sri Lanka and then exported; otherwise they are directly exported through recommended forwarders.

In fact, SLC operates in multiple networks, in particular four networks, as it facilitates for four prime companies. However, it has to search for orders from large manufacturers especially in the off-season (April–August), as large manufacturers tend to place orders with SMEs only when faced with capacity constraints. Consequently, the number of supply networks in which this company operates, changes according to the number of large manufacturers who place the

orders. Therefore, this company needs to be highly flexible to operate in different networks.

The above case discussion shows that although different operational practices may appear in different circumstances, in general SME apparel manufacturers operate mostly as the production capacity providers to the large manufacturers. They do not have control of any of the strategic level operations decisions such as product development, sourcing, quality assurance in the clothing networks. Essentially they provide mechanism for clothing supply networks to flex their capacity and their capabilities according to the volume and type of orders being placed, by the major retailers and brand owners.

5.5 Policy Implications

Policy implications are evident from the study for government authorities, industrial companies and the study also has implications for academic research. Government authorities should facilitate the development and maintenance of healthy relationship between large apparel manufacturers and SMEs, as SMEs provide essential capacity and capability flexibility for large manufacturers, enhancing their production competencies and expertise, and thus enhancing their ability to take on large and varied supply contracts. Such skills, resources, and competencies are necessary to cope with the enormous global competition in the apparel sector.

Industrial personnel at both strategic and functional level operations should understand the importance of network structures, their mode of operation, and the relationships among large companies as well as between large and smaller companies. Large apparel manufacturers should maintain accurate data bases on the competencies and capacities of SMEs, and should develop and maintain healthy relationships with them. They should also be prepared to share information on future demand with partner organizations. Such practices will help to ensure that large manufacturers are sufficiently flexible to cope with the dynamics in the global apparel market.

SMEs must also be proactive to ensure that they can participate actively in supply networks. They should develop awareness and obtain market intelligence on requirements, and trends in the global apparel market. Such approaches may be too demanding for single SMEs or prohibitive in cost due to limited resources. However, there may be value in collaborating with other SMEs, organized in clusters to develop such market intelligence skills. Further, having a comprehensive understanding of the operation of entire supply networks and the position of SMEs within them, is important for decision making of SMEs.

The structure, operation, and dynamics of supply networks in the international clothing industry provide many avenues for future research, both at the strategic and practical levels. It provides an opportunity to examine the possibility of carrying out similar types of study in other developing countries (e.g. Bangladesh,

Thailand, Vietnam) which supply for the global apparel market. Furthermore, supply network structures and their implications for SMEs are relevant to many other globally dispersed industries.

5.6 Conclusions

Supply network structures, their operation, and governance are an important area for academic researchers as well as the business community. Interest has accelerated as more industries have become globally dispersed. The relationships between SMEs and internationally dispersed supply networks are clearly important. The international clothing industry is highly globalized and mobile. This chapter has examined the operational strategies of SMEs in different supply networks in the international clothing industry.

This chapter has briefly reviewed network structures presented by academic researchers from the perspectives of the relationship with, and engagement of SMEs. However, the review of network structures highlights the need for further research on SMEs and their operation within supply network structures. The chapter has discussed the operations of three different Sri Lankan apparel manufacturing companies that operate in different network structures. The study shows that SMEs mostly operate as a mechanism to flex both capability and capacity of the network and that this has implications for both, SME's and prime players in the network.

The chapter has briefly noted policy implications for government authorities and the business community. Government authorities should facilitate the development and maintenance of healthy supply networks with strong relationships between large companies and SMEs. Both the large and SME apparel manufacturers should also fully acknowledge and appreciate the significance of healthy network structures and their practical implications in order to derive the maximum benefits. Further, detailed studies of supply network structures and their operations are needed to inform policy makers and help both large organizations and SMEs to engage in mutually beneficial relationships to serve world markets.

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Index